EXHIBIT
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TRISTAR PRESSURE COOKER EXAMINATION
MODEL #PPC770

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I. PROJECT SUMMARY

PROJECT ASSIGNMENT

S-E-A, Ltd. (S-E-A) Technical Consultants Jeffrey A. Edwards and Jason M. Mattice have been asked to conduct an examination of electric pressure cookers. There have been consumer reported incidents involving the Tristar Power Pressure Cooker Model #PPC770 claiming that the subject pressure cooker unit reportedly malfunctioned and caused some injuries. Four Tristar Products, Inc. pressure cookers were tested and examined. All four cookers were exemplar pressure cookers received from Tristar.

SCOPE OF PROJECT

S-E-A was asked to review the provided documents and examine the exemplar pressure cookers in order to identify anomalous performance of the units and to exercise various features by intentionally misusing the appliance by operating it with certain key components disabled.

EXECUTIVE SUMMARY

The evaluation of each pressure cooker was composed of two phases. The first phase involved a thorough inspection to document the physical characteristics, dimensions, and functionality of the pressure cooker. The second phase determined the operational characteristics of each cooker under various conditions using wireless data sensors to measure the temperature and pressure within the cooker during each test.

Lid removal tests showed that the lids could not be removed by a strong adult male while the pressure cooker was fully pressurized. When the pressure was reduced, the test technician was eventually capable of twisting off the lid. The internal pressure at the point of forced lid removal was no longer high enough to develop significant upward force or velocity on the lid, which was due, in part, to the strong grip required to remove the lid in the first place. Due to the strength and grip required to remove the lid, combined with the lower internal pressure, the test technician was able to maintain control of the lid for all lid removal tests.

Tests were performed to evaluate the performance of the pressure cooker when using the cook cycle function buttons on the control panel. At the conclusion of each cook cycle test and prior to the depressurization of the inner pot, the lid and pressure release valve were checked to ensure they were secured properly. The lid was found locked and secured and the pressure release valve was found intact and secured at the conclusion of every cook cycle test for all pressure cookers. Each pressure release valve was used to vent the steam and depressurize the inner pot for the test where the cooker could build up significant pressure. Once the depressurization was complete, the lid was unlocked and

removed. The gasket and all other components were inspected and found to be intact and secured after every test.

A series of tests were performed with various levels of fluid in the inner pot. The fluid level was varied from empty, to minimum, to 3/5, and to maximum, as defined by the graduations on the inner pot. These tests revealed that the minimum fill condition showed the highest levels of pressure and the highest maximum temperature readings compared to every other test performed throughout this entire report. Each test completed normally without damaging any components and without expulsion of the contents or components of the pressure cooker.

To compliment the lid removal tests, a series of examinations evaluating the performance of the cooker for various locking conditions were performed. The objective of the lid locking tests was to vary the lid locking position from fully locked, to half-locked, to barely locked, to unlocked and see if running a cook cycle would cause the lid to open during operation. For all but the fully locked position tests, the cooker failed to reach full pressurization and typically slowly leaked steam through the float valve or the gasket on the lid. The lid, as well as all other components, remained undamaged and secured to the pressure cooker during every lid lock test with no expulsion of fluid or steam. The tests and calculations show that a lid will not come off a pressure cooker on its own once the cooker becomes fully pressurized and the lid and outer pot locking tabs are engaged, regardless of lid locking position.

A test series was designed to exercise various features by operating it with certain key components disabled. This examination documented cooker performance with the pressure release valve clogged, the float valve clogged, the temperature sensor disabled, and the pressure sensor disabled. With either sensor disconnected, the cooker was unable to operate and produced an error code on the control panel. With either the pressure release valve or the float valve clogged, the cooker was still able to reach full operational pressure. Both tests with clogged openings yielded performance that was not distinguishably different from the tests of standard operation. In the case of a clogged pressure release valve, the pressure could not be manually dissipated and the lid could not be forcibly removed right away. The owner's manual addresses the situation of a clogged valve, and the directions describe a reasonable method to solve the problem. Instructions in the owner's manual also describe how to prevent clogging. This test series shows that the pressure cooker mechanisms provide robust and redundant methods that are capable of preventing hazardous conditions during operation.

CONCLUSIONS

- **No anomalous performance occurred during any of the tests; the lids, gaskets, moveable parts, and heated contents behaved as expected.**
- **Each cooker with a locked or partially locked lid was picked off the ground using only the lid handle to verify that the locking tabs were engaged and lid could stay locked. All four cookers examined in this report were capable of lifting the locked cooker off the ground using only the lid handle.**
- **The lid removal test result calculations show that the initial lid velocity due to the release of internal pressure may be as high as 16.0 feet per second.**

Any forces exerted by an operator before, during, or after the disengagement of the locking tabs would have a significant effect on the motion of the lid under such circumstances.

- **In all three lid removal tests, the test technician was able to maintain control of the lid despite the intentional misuse.**
- **The pressure cooker owner's manual contains multiple statements that describe instructions directing users not to force the lid open or open the cooker prior to full internal pressure release.**
- **S-E-A calculated that it would take an internal absolute pressure of 254 kPa (36.9 psi) to lift the weighted cap off of the exhaust valve, at which point the internal pressure would be relieved in a controlled manner per normal operation.**
- **Statistical analysis of the test data shows that the pressure required to lift the weighted cap, venting the internal pressure, is 15 standard deviations above the average of the maximum observed pressures.**
- **An upward force of at least 18.2 N (4.1 pounds) is necessary to dislodge the weighted cap from its retainer ring; the correlating internal absolute pressure of 3,155 kPa (458 psi) would not be expected to be developed given the automatic relief feature described above.**
- **The minimum fill condition has the shortest pressurization times, as well as the highest pressures compared with higher and lower fill levels.**
- **The pressure and temperature measurements for the unlocked and partially locked lid position tests are similar to one another and show that the internal pressures remain near the ambient air pressure.**
- **The locking tab angles are not steep enough for the lid to become dislodged and ejected from the cooker once it becomes fully pressurized without additional external torque applied to the lid. The tests and calculations show that a lid will not rotate toward an unlocked position and come off a pressure cooker on its own after the cooker becomes fully pressurized and the lid and outer pot locking tabs are engaged, regardless of lid locking position.**
- **Redundant features of the pressure cooker prevent development of extreme temperatures and pressures that could result in forceful ejection of appliance components.**

II. PROCEDURES

1. S-E-A reviewed the following file materials for this report:
   - A list of incident information provided by Tristar Products for multiple subject pressure cookers;
   - An incident report for Mr. Philip Charland involving a Power Pressure Cooker XL Model #PPC770;
   - Owner's manual for the Power Pressure Cooker XL 6-Quart Digital Pressure Cooker for Model #PPC770;
2. S-E-A conducted extensive inspections and product examinations of exemplar pressure cookers between October 2 and March 24, 2016, including:

- Normal operating cook cycles;
- Attempting to remove lid while pressurized;
- Operating pressure cooker while lid was not completely locked;
- Operating pressure cooker with various fluid levels in the inner pot;
- Operating the cooker with various sensors disabled or valves clogged.

3. S-E-A performed calculations to determine the theoretical pressures and forces required to initiate various outcomes.
4. S-E-A conducted statistical analyses of the test data to determine performance metrics for a large population of exemplar pressure cookers.

III. EQUIPMENT AND RESULTS

PRESSURE COOKER MODEL AND COMPONENTS

The product involved in the reported incidents was the Power Pressure Cooker XL 6-Quart Digital Pressure Cooker Model #PPC770 (**Figure 1**). There were a total of four pressure cookers examined. All four pressure cookers were new and sent from Tristar Products. The pressure cookers will be referred to as the sample exemplar pressure cookers in this report.

The pressure cooker is composed of five primary sub-assemblies: lid, pots, outer housing, LCD control panel, and the base internal electrical components. The outer lid (**Figure 2**) contains the lid handle, pressure release valve, pressure release knob, and float valve. The pressure release valve is composed of a cylindrical weighted cap, an internal conical stopper, and metal exhaust valve. A metal snap ring holds the cylindrical weighted cap to the metal exhaust valve, and the conical stopper inside the weighted cap seats into the through hole of the metal exhaust valve. When the pressure release knob is set to the open position, it elevates the pressure release valve weighted cap to allow the cooker steam to vent and depressurize the cooker.

The lid is placed on the top of the cooker housing and is secured by rotating it counter-clockwise. The rotation positions the lid locking tabs so that they can engage the outer pot locking tabs when the cooker becomes pressurized, which restrains the lid to the cooker housing during operation. Additionally, there is a slider with a through hole in the lid that is aligned with the float valve when the lid is in the locked or unlocked position.

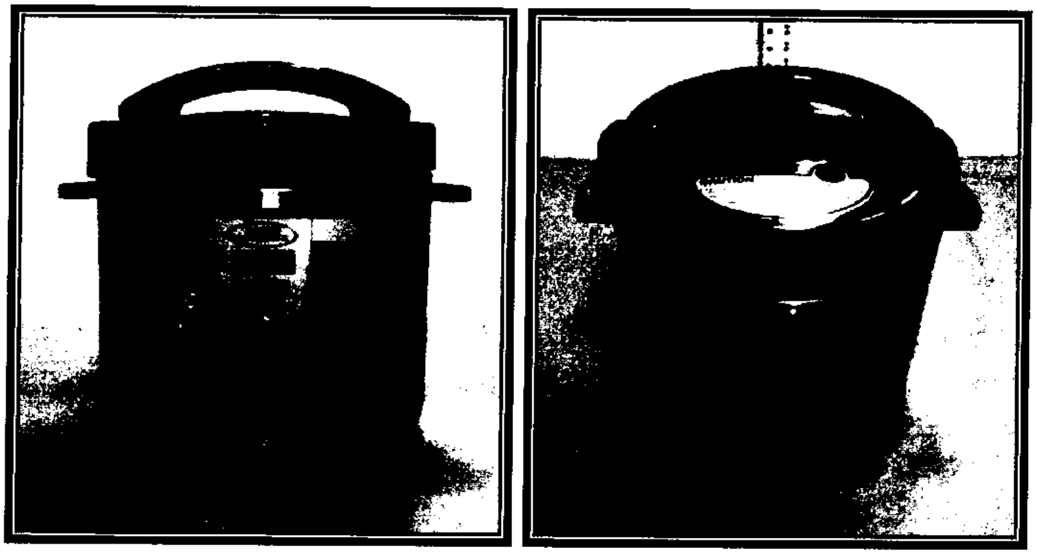


FIGURE 1: Photographs of PPC770 pressure cooker lid and LCD control panel.

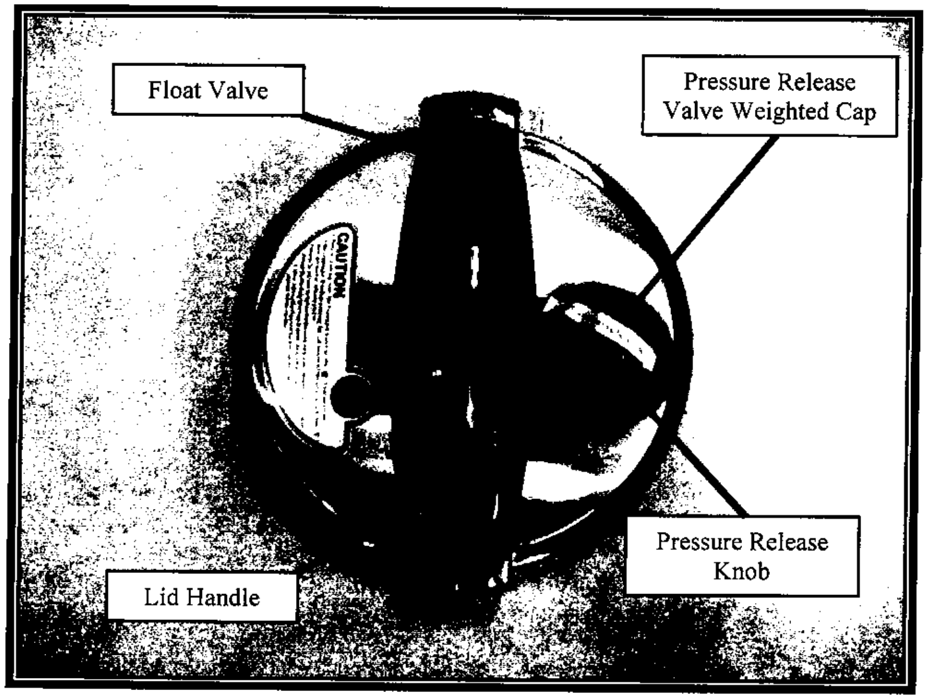


FIGURE 2: Photograph of pressure cooker outer lid with handle, pressure release valve, pressure release knob, and float valve.

The inner lid (**Figure 3**) contains a perforated clog resistant liner, float valve washer grommet, gasket, pressure release valve port, and six lid locking tabs. The perforated clog resistant liner protects the metal exhaust valve and float valve from internal clogs and debris by creating a barrier between the cooking contents and the inner lid surface. The float valve is composed of a metal valve and a washer grommet. The float valve normally elevates when pressure builds in the cooker. The vertical translation of the float valve engages a slider hole in the outer lid (**Figure 4**), which normally prevents the lid from rotating and unlocking until the pressure has been released.

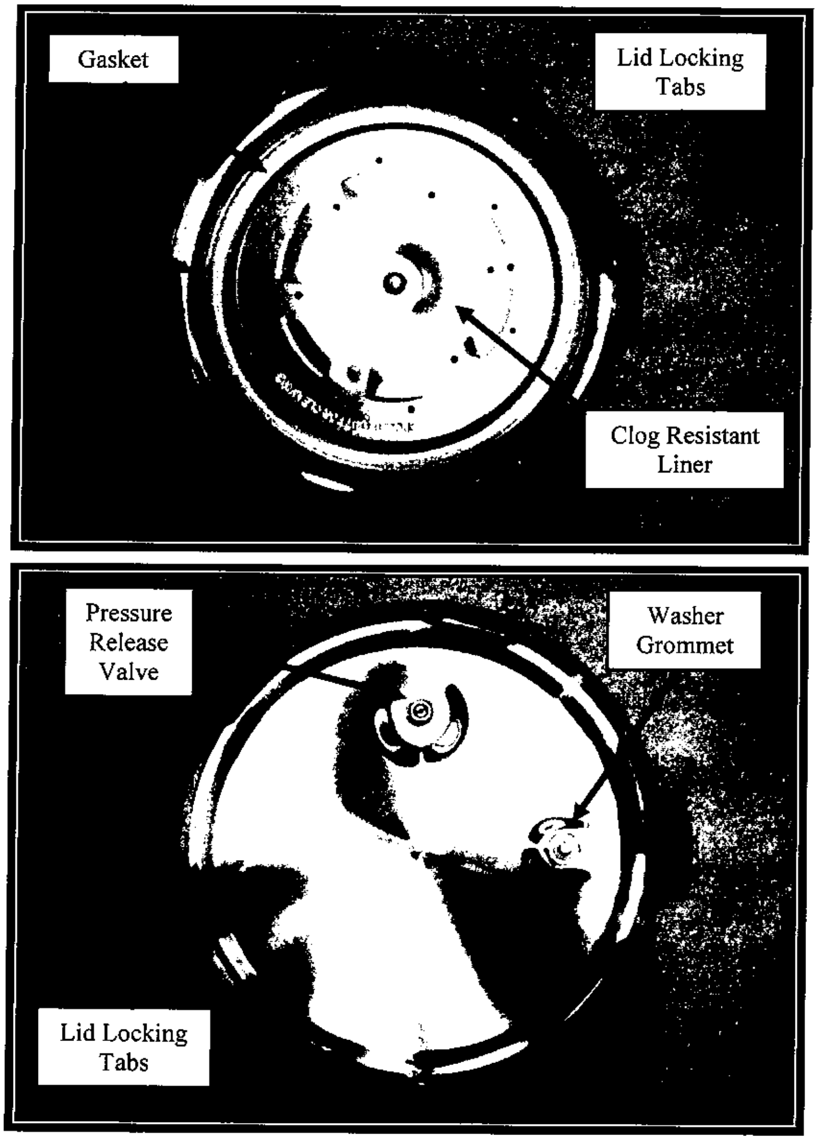


FIGURE 3: Photographs of pressure cooker inner lid with (top) and without (bottom) clog resistant liner, washer grommet, gasket, pressure release valve, and lid locking tabs.

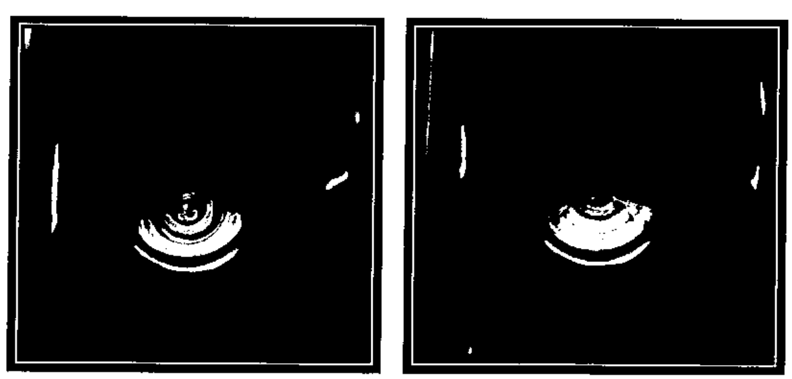


FIGURE 4: Photographs of float valve engaging slider hole in outer lid (left) and slider preventing float valve from elevating (right).

Prior to locking the lid, an inner pot is seated inside the outer pot. The lid is placed on the top of the cooker housing and is secured by rotating it counterclockwise. When the lid is attached to the base, it aligns the gasket around the circumference of the inner lid with the circumference of the inner pot, forming a seal and enclosing the inner pot cavity with the inner lid. The lid rotation also positions the lid locking tabs so that they can engage the outer pot locking tabs (**Figure 5**). The two sets of locking tabs are fully engaged when the lid is in the closed position. The locking tabs resist the upward force from the internal pressure exerted on the underside of the lid that is generated during operation, restraining the lid to the cooker base.

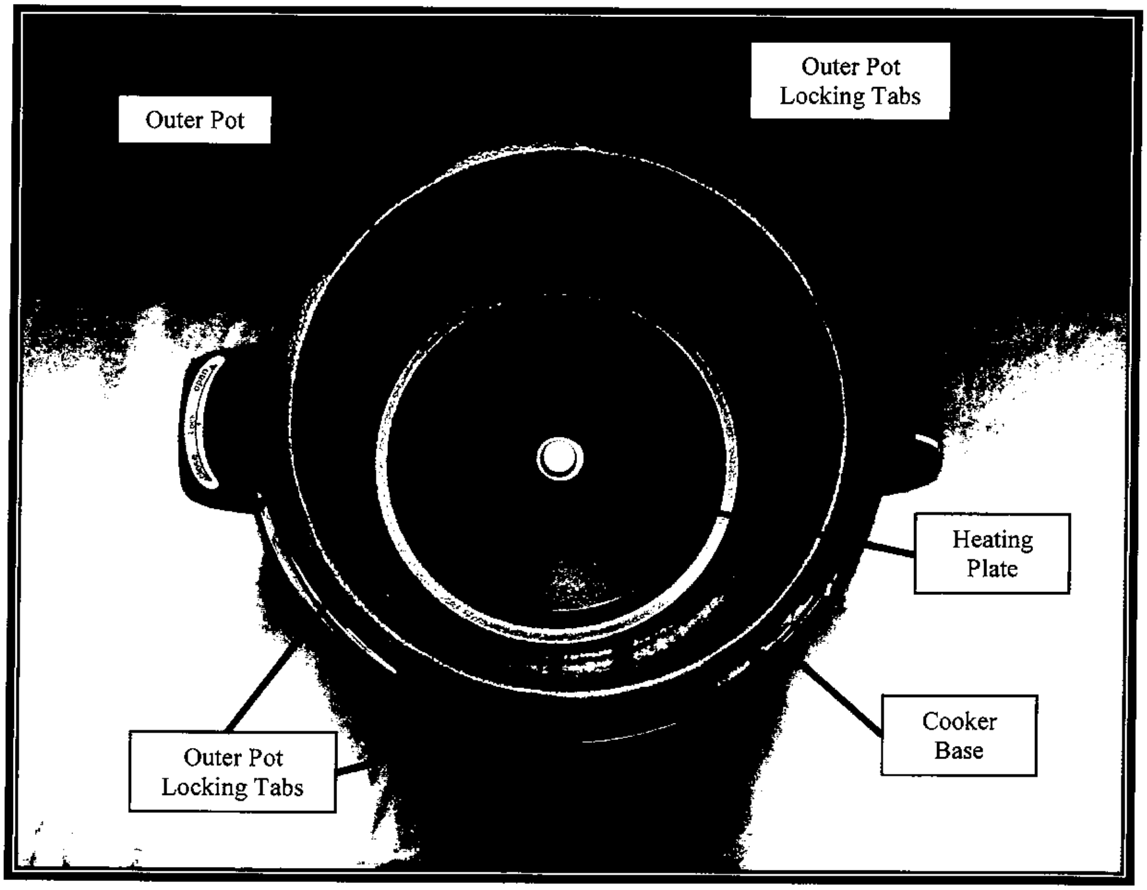


FIGURE 5: Photograph of pressure cooker outer pot locking tabs.

PRESSURE COOKER EXAMINATIONS

The evaluation of each pressure cooker was composed of two phases. The first phase involved a thorough inspection to document the physical characteristics, dimensions, and functionality of the pressure cooker. The second phase was comprised of a test series that would determine the operational characteristics of each cooker under various conditions. The information regarding each pressure cooker examination is listed in **Table 1**.

Cooker Model #	Label	Date Code
PPC770	Sample J	1503L
PPC770	Sample K	1503L
PPC770	Sample L	1503L
PPC770	Sample M	1503L

TABLE 1: List of pressure cookers examined with model numbers and date codes.

A comprehensive inspection protocol worksheet was created to ensure that the procedures used to inspect each pressure cooker prior to testing were uniform. The 47-point inspection documentation worksheet was used to record all notes and observations for each pressure cooker inspection. Each inspection evaluated the following cooker components: packaging, lid, pressure release valve, float valve, gasket, clog resistant liner, inner and outer housing, internal electrical components, wiring, and control panel. The inspections documented various aspects of the cooker including component weights, locking tab dimensions, valve dimensions, pressure and time settings, etc. A copy of the inspection documentation worksheet is attached to this report in **Attachment 1**.

Once the cooker inspections were completed, each pressure cooker was run through a series of tests. A test matrix was developed to quantify the performance of the cooker under various operational conditions. The test matrix listing the operational conditions of each test is shown in **Table 2**. Water was used in the inner pot as the cooker medium during all tests. The column listing the cook pressures in Table 2 refers to the corresponding nominal gauge pressure, or pressure range, setting shown on the control panel display when using the specific cook cycle function.

First, multiple attempts were made to remove the lid while the cooker was pressurized at various pressures in order to determine under what conditions the lid could be removed by a consumer. Next, each pressure cooker was run through a series of operation cycles to evaluate the performance and functionality of the cooker components under normal operating conditions. The level to which the inner pot was filled with water was varied with the cooker set to its maximum pressure setting using the "Canning/Preserving" function. The cooker monitoring mechanisms were evaluated by systematically disabling each one. This evaluation documented cooker performance with the pressure release valve clogged, the float valve clogged, the temperature sensor disabled, and the pressure sensor disabled. The performance of the lid locking mechanism was evaluated by varying the lid position in multiple intervals between the locked and unlocked positions.

A comprehensive test protocol checklist was created to ensure that the procedures used to test each pressure cooker were uniform. The 45-point test checklist outlines procedures for setting up the data acquisition, preparing the cooker for testing, documenting cook times, and recording test data for analysis. A copy of the test protocol checklist is attached to this report in **Attachment 2**.

Test Number	Test Topic	Cook Setting	min Cook Time	kPa Cook Pressure	Fill Level	Pressure Sensor	Temp Sensor	QR Valve	Float Valve	Lid	Notes
1	Cook Cycle	Canning/Preserving	60	83	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
2	Cook Cycle	Soup/Stew	60	50	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
3	Cook Cycle	Slow Cook	60	---	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
4	Cook Cycle	Beans/Lentils	30	50	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
5	Cook Cycle	Rice/Risotto	25	50	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
6	Cook Cycle	Fish/Vegetables Steam	10	50	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
7	Cook Cycle	Chicken/Meat	60	50	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
8	Cook Cycle	Keep Warm	30	---	3/5	Enabled	Enabled	Clear	Clear	Locked	Normal cook cycle
9	Cook Cycle	Canning/Preserving	60	83	3/5	Enabled	Enabled	Clear	Clear	Locked	Delay timer set to 30 minutes
10	Fill Level	Canning/Preserving	60	83	Max	Enabled	Enabled	Clear	Clear	Locked	Max fill condition
11	Fill Level	Canning/Preserving	60	83	Min	Enabled	Enabled	Clear	Clear	Locked	Minimum fill condition
12	Fill Level	Canning/Preserving	60	83	Empty	Enabled	Enabled	Clear	Clear	Locked	Empty condition - KEEP BELOW 280 F
13	Lid Lock	Canning/Preserving	60	83	3/5	Enabled	Enabled	Clear	Clear	Unlocked	Unlocked condition
14	Lid Lock	Canning/Preserving	60	83	3/5	Enabled	Enabled	Clear	Clear	5% Locked	Locked 5%
15	Lid Lock	Canning/Preserving	60	83	3/5	Enabled	Enabled	Clear	Clear	50% Locked	Locked 50%
16	Other	Canning/Preserving	60	83	3/5	Enabled	Enabled	Blocked	Clear	Locked	Clog pressure release (PR) valve
17	Other	Canning/Preserving	60	83	3/5	Enabled	Enabled	Clear	Blocked	Locked	Clog float valve in down position
18	Other	Canning/Preserving	0	83	3/5	Disabled	Enabled	Clear	Clear	Locked	Disable pressure sensor
19	Other	Canning/Preserving	0	83	3/5	Enabled	Disabled	Clear	Clear	Locked	Disable temperature sensor
20	Other	Canning/Preserving	0	83	3/5	Disabled	Disabled	Clear	Clear	Locked	Disable pressure/temp sensor
21	Lid Remove	Canning/Preserving	15	83	3/5	Enabled	Enabled	Clear	Blocked	Locked	Unlock using 60 in-lb while cooker under pressure

TABLE 2: Test matrix listing pressure cooker test procedures.

EXAMINATION EQUIPMENT

Two protective enclosures were constructed using aluminum tubing and clear acrylic sheets, which function to contain ejected components or contents in the event a pressure cooker incident were to occur. The two enclosures were built to allow the test technician to test two cookers simultaneously. The test enclosures are shown in **Figure 6**.

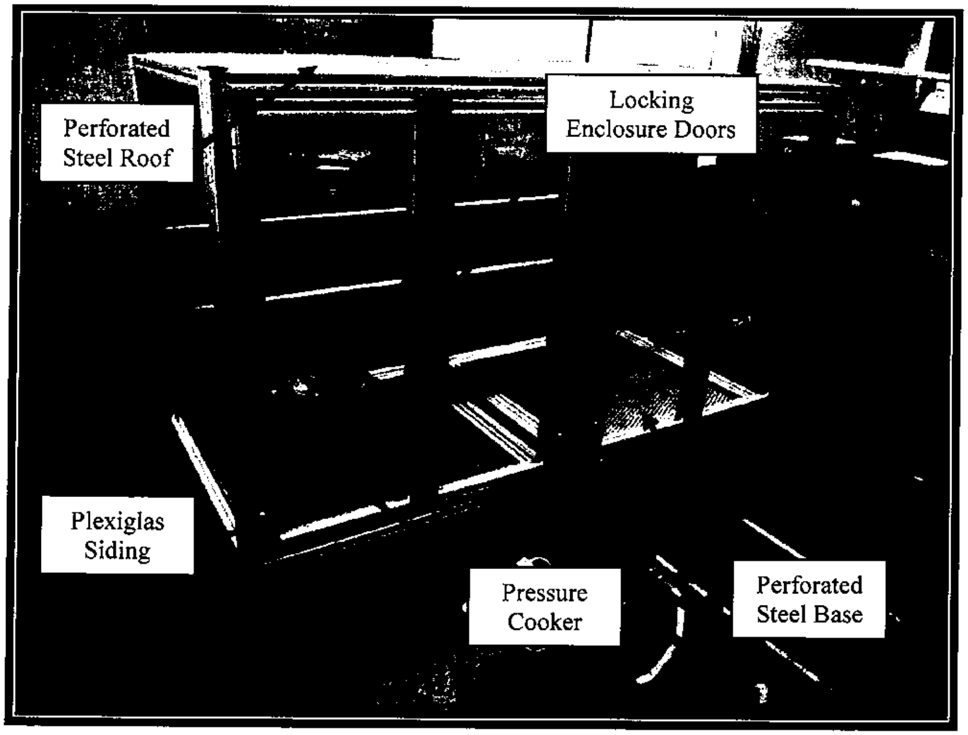


FIGURE 6: Photograph of pressure cooker test enclosures.

When applicable, each test recorded temperature and absolute pressure data using a DataTrace RF Micropack Radio Frequency (MPRF) Pressure Data Logger (**Figure 7**). The wireless data logger is programmable and collects up to 8000 data points in real time, 4000 each for pressure and temperature readings. The real-time data permits monitoring of temperature and pressure during the course of the test. The detailed specifications for the MPRF data loggers are attached in this report in **Attachment 4**.

The term "pressure" is mentioned throughout this report and typically refers to absolute pressure, unless it is noted otherwise. Gauge pressure is another term used and it is defined as the difference between the absolute pressure and atmospheric pressure. Atmospheric pressure is around 101 kPa on average and typically ranges from 96 kPa to 105 kPa. Gauge pressure is sometimes referred to as the "pressure range" or "cook pressure" in this report. The pressure range is the difference between the maximum absolute pressure and the initial absolute pressure (approximately atmospheric pressure) measured during a test. The cook pressure is displayed on the control panel when selecting a cook cycle and is an approximation of the target pressure range. For these reasons, pressure range and cook pressure are used interchangeably for gauge pressure in some instances throughout this report. The definitions and formulas for the various pressure terms are listed in **Table 3**.

Pressure Term	Definition	Value
Atmospheric (ATM)	Environmental ambient air pressure	≈101 kPa (±4 kPa)
Absolute (ABS)	Pressure relative to zero (vacuum)	GA + ATM
Gauge (GA)	Pressure relative to ambient air	ABS – ATM
Pressure Range (PR)	Max test pressure difference	Max ABS – ATM
Cook Pressure (CP)	Cooker nominal pressure range	≈PR

TABLE 3: Summary of the pressure terms and definitions.

The compact size of the MPRF data logger allows the test technician to mount the logger to the interior side of the inner lid so that the logger is above the water level during operation. This mounting position allows the logger to properly measure the temperature and pressure of the cooker. This mounting method, along with the wireless functionality of the data loggers, allows the cooker to remain structurally intact during testing because there is no need to drill holes into the cooker for wired thermocouples or pressure gauges.

The MPRF data loggers come with a DataTrace DT Pro MPRF-H USB Interface (**Figure 7**) and DataTrace Pro Plus Version 1.2 software (**Figure 8**) that allow a computer to read and program the loggers. The software can be used to set the sampling rate, monitor the live feed from the data logger, as well as create various reports from the data collected during the test.

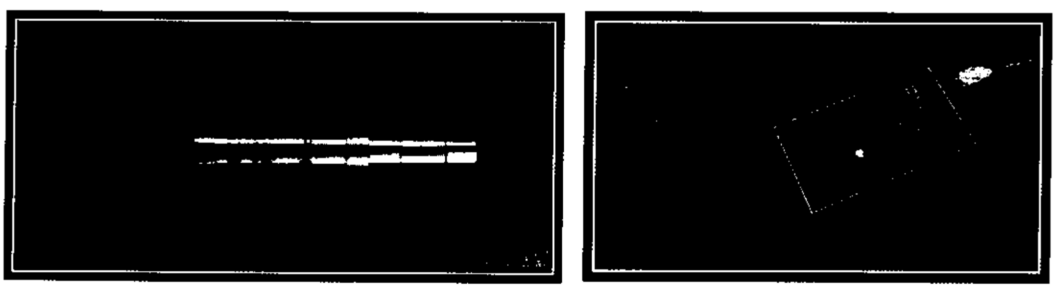


FIGURE 7: Photographs of the MPRF wireless data logger (left) and the DataTrace MPRF-H Interface (right) used during the examinations.

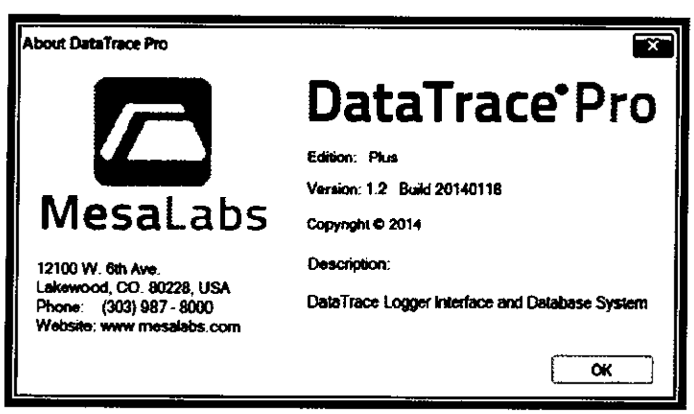


FIGURE 8: DataTrace Pro Plus software information.

PRESSURE COOKER INSPECTION MEASUREMENTS

During each inspection, a number of measurements were recorded to assess the variation in the pressure cooker component specifications for each exemplar cooker produced by Tristar Products, Inc. **Table 4** lists the measurements and data recorded for each pressure cooker. The measurements focused on the specifications for the lid, locking tabs, pressure release valve, float valve, and control panel settings for each cooker.

Inspection Measurements	Sample J PPC770 1	Sample K PPC770 2	Sample L PPC770 3	Sample M PPC770 4	Units
Weight of lid	950	954	948	952	*g*
Average thickness of lid locking tabs	0.84	0.90	0.74	0.84	*mm*
Average length of lid locking tabs	5.77	5.89	5.71	5.74	*mm*
Average thickness of outer pot locking tabs	6.44	6.45	6.41	6.35	*mm*
Length of outer pot locking tab (adjacent to pin lock)	7.02	6.57	6.91	6.71	*mm*
Average circumferential angle of outer pot locking tabs	0.60	0.58	0.67	0.58	*deg*
Average lateral angle of outer pot locking tabs	1.02	0.57	0.73	0.35	*deg*
Average force to remove pressure release weighted cap	4.1	4.4	4.3	5.6	*lbs*
Weight of pressure release weighted cap	93	93	92	93	*g*
Minimum distance between retainer ring edges	5.79	6.22	7.33	5.64	*mm*
Inside diameter of metal exhaust valve	2.78	2.68	2.81	2.72	*mm*
Outside diameter of metal exhaust valve	9.70	9.56	9.68	9.61	*mm*
Weight of metal float valve	1.7089	1.7028	1.7002	1.6980	*g*
Outside diameter of metal float valve	8.91	8.86	8.84	8.85	*mm*
Weight of washer grommet	0.2596	0.2753	0.2792	0.2799	*g*
Inside diameter of washer grommet (uninstalled)	4.12	4.55	4.24	3.87	*mm*
Outside diameter of washer grommet (installed)	11.96	11.95	12.05	11.50	*mm*
Weight of gasket	48	48	46	49	*g*
Thickness of gasket	1.44	1.34	1.66	1.42	*mm*
Weight of inner pot	596	580	575	581	*g*
Minimum time setting	10	10	10	10	*min*
Maximum time setting	120	120	120	120	*min*

TABLE 4: Summary of the pressure cooker inspection measurements and data.

PRESSURIZED LID REMOVAL TEST RESULTS

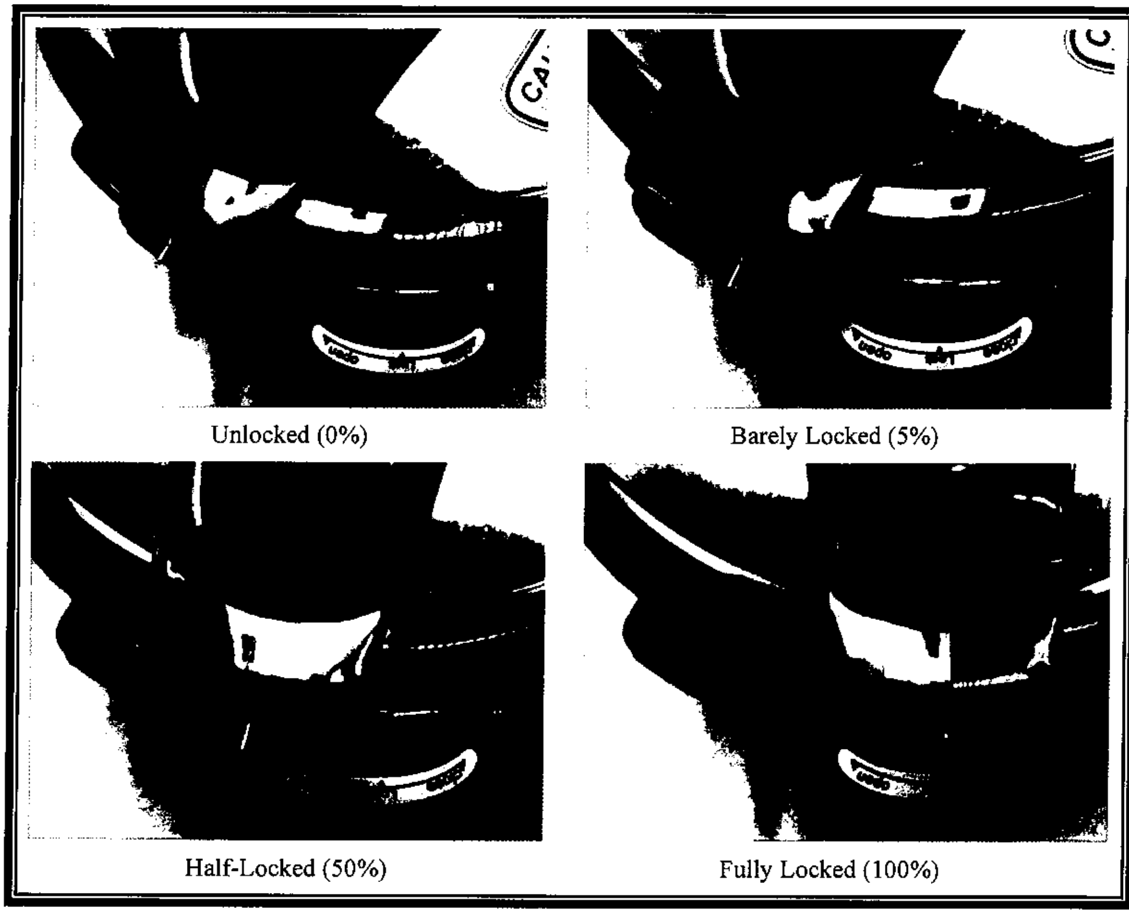
Lid removal tests were performed in order to test the ability of the pressure cooker locking mechanisms to function effectively and evaluate the possibility of an operator opening the lid of a pressurized cooker. When the cooker internal pressure begins to increase, the contact forces between the lid locking tabs and the outer pot locking tabs begin to increase. As the locking tab contact forces increase, the friction between the locking tabs increases, making it more difficult to twist open the lid. In order to open a lid that is fully and properly locked while the cooker is pressurized, an operator would have to defeat the float valve locking mechanism and apply a large enough torque to overcome the locking tab friction. The lid removal tests were designed to determine what pressures, and corresponding locking tab friction, an operator could overcome by applying a reasonable lid torque to open the lid.

Trials were performed to determine a reasonable amount of torque that could be applied to the lid given the placement of lid and cooker handles. Lid torque was applied by hand without the use of tools or accessories. It was determined that approximately 60 in-lb of torque could be repeatedly applied to the lid by the user. This value is used to define a reasonable amount of torque, or corresponding force, applied to the lid during these tests.

An exemplar cooker was selected for the lid removal testing. The inner pot was filled to the "3/5" line with water which equated to approximately 3300 grams or 3.3 liters. The cooker was brought to full operating pressure using the "Canning/Preserving" cook cycle. The "Canning/Preserving" cook setting was chosen because it has the highest cook pressure, 83 kPa, of all cook settings as listed in the owner's manual. The power to the cooker was shut off once it reached operational pressure. With the cooker still pressurized, the 60 in-lb of torque was applied to the lid in an attempt to defeat the locking mechanism and open the cooker while it was pressurized.

Without power, the cooker slowly cooled with a resulting decrease in internal pressure. At regular pressure intervals, the lid torque (approximately 60 in-lb) was applied until the lid could be moved or removed completely. The internal pressure was monitored with the wireless pressure gauge and the absolute pressure was recorded at various intervals. The cooker absolute pressure ranged from 160 kPa down to 105 kPa in regular intervals.

The lid removal tests were performed with three separate lid positions (**Figure 9**): fully locked (100%), half-locked (50%), and barely locked (5%). Figure 9 also shows the unlocked position for comparison. The percentages are merely indicative of the general locking positions and not exact positioning figures. In order to fully lock the lid, the lid must be seated correctly on the cooker and rotated approximately 30 degrees counterclockwise. The half-locked condition requires about 15 degrees of rotation and the barely locked condition requires about 5 degrees of lid rotation. For all three positions, there is engagement between the lid locking tabs and the outer pot locking tabs so that the lid can be restrained during operation. The float valve mechanism normally prevents the lid from rotating and fully unlocking. With the lid fully locked, the float valve would elevate when the inner pot was pressurized and engage the through hole in the lid (Figure 4). During the lid removal test for the fully locked position, the ability to slightly rotate the lid was monitored for each torque application. The lid removal test results for the fully locked lid position are summarized in **Table 5**.



Unlocked (0%) | Barely Locked (5%)

Half-Locked (50%) | Fully Locked (100%)

FIGURE 9: Photographs comparing the relative locking positions of the lid.

For the half-locked and barely locked lid positions, the float valve had to be manipulated in order to complete the lid removal tests because the valve could not engage the through hole in the lid. When the lid is not fully locked, steam leaks through the float valve because the valve is not permitted to elevate by the through hole slider in the lid. The leaking steam makes it difficult for the cooker to build internal pressure. To account for this, the float valve was intentionally clogged and fixed in the down position to allow the cooker to reach full operational pressure so that the lid removal tests could be completed. The lid removal test results for the half-locked lid position are summarized in **Table 6**. The lid removal test results for the barely locked lid position are summarized in **Table 7**.

A comprehensive lid removal test protocol checklist was created to ensure that the procedures used to test each pressure cooker were uniform. The 39-point test checklist outlines procedures for setting up the data acquisition, preparing the cooker for testing, documenting cooker information, and recording test data for analysis. This checklist is similar to the test protocol checklist mentioned previously, but only applies to the methods and procedures used for the lid removal test examinations. A copy of the lid removal test protocol checklist is attached to this report in **Attachment 3**.

Lid Closed Position	Float Valve State	kPa Cooker Pressure	Float Valve Position	Lid Movement	Lid Locking State
100%	Normal	160	Up	No	Closed
100%	Normal	155	Up	No	Closed
100%	Normal	150	Up	No	Closed
100%	Normal	145	Up	No	Closed
100%	Normal	140	Up	No	Closed
100%	Normal	135	Up	No	Closed
100%	Normal	130	Up	No	Closed
100%	Normal	125	Up	No	Closed
100%	Normal	120	Up	No	Closed
100%	Normal	115	Up	No	Closed
100%	Normal	110	Up	Yes	Open

TABLE 5: Summary of the lid removal test for fully-locked (100%) lid position.

Lid Closed Position	Float Valve State	kPa Cooker Pressure	Float Valve Position	Lid Movement	Lid Locking State
50%	Blocked	160	Down	No	Closed
50%	Blocked	155	Down	No	Closed
50%	Blocked	150	Down	No	Closed
50%	Blocked	145	Down	No	Closed
50%	Blocked	140	Down	No	Closed
50%	Blocked	135	Down	No	Closed
50%	Blocked	130	Down	No	Closed
50%	Blocked	125	Down	No	Closed
50%	Blocked	120	Down	No	Closed
50%	Blocked	115	Down	No	Closed
50%	Blocked	110	Down	Yes	Open

TABLE 6: Summary of the lid removal test for half-locked (50%) lid position.

Lid Closed Position	Float Valve State	*kPa* Cooker Pressure	Float Valve Position	Lid Movement	Lid Locking State
5%	Blocked	160	Down	No	Closed
5%	Blocked	155	Down	No	Closed
5%	Blocked	150	Down	No	Closed
5%	Blocked	145	Down	No	Closed
5%	Blocked	140	Down	No	Closed
5%	Blocked	135	Down	No	Closed
5%	Blocked	130	Down	No	Closed
5%	Blocked	125	Down	No	Closed
5%	Blocked	120	Down	No	Closed
5%	Blocked	115	Down	No	Closed
5%	Blocked	110	Down	Yes	Open

TABLE 7: Summary of the lid removal test for barely-locked (5%) lid position.

PRESSURE COOKER OPERATIONAL TEST RESULTS

Each pressure cooker was run through a series of operation cycles to evaluate the performance and functionality of the cooker components under various operating conditions. Prior to each test, the inner pot was filled to the water level specified in the test matrix. The water was emptied and refilled after each consecutive test. During each test, wireless test sensors were used to continuously monitor and record the internal cooker temperature and absolute pressure. All data was sampled at a rate of 1 sample every 2 seconds. This data is used to analyze the performance of the cooker and understand the variation in the performance metrics from cooker to cooker. The temperature and pressure time series data was recorded and plotted for all applicable tests **(Figure 10)**. **Attachment 5, 6, 7, and 8** show the plotted test data sheets for each recorded test for Samples J, K, L, and M.

The first set of tests evaluated the performance and functionality of the cooker components under normal operating conditions. These tests are identified as "Cook Cycle" in the test matrix (Table 2). The cook cycle buttons on the LCD control panel were used to program the pressure cooker for each cook cycle test. If applicable, the length of the cook cycle was extended from the default value in order for the data loggers to capture multiple heating/pressurizing cycles.

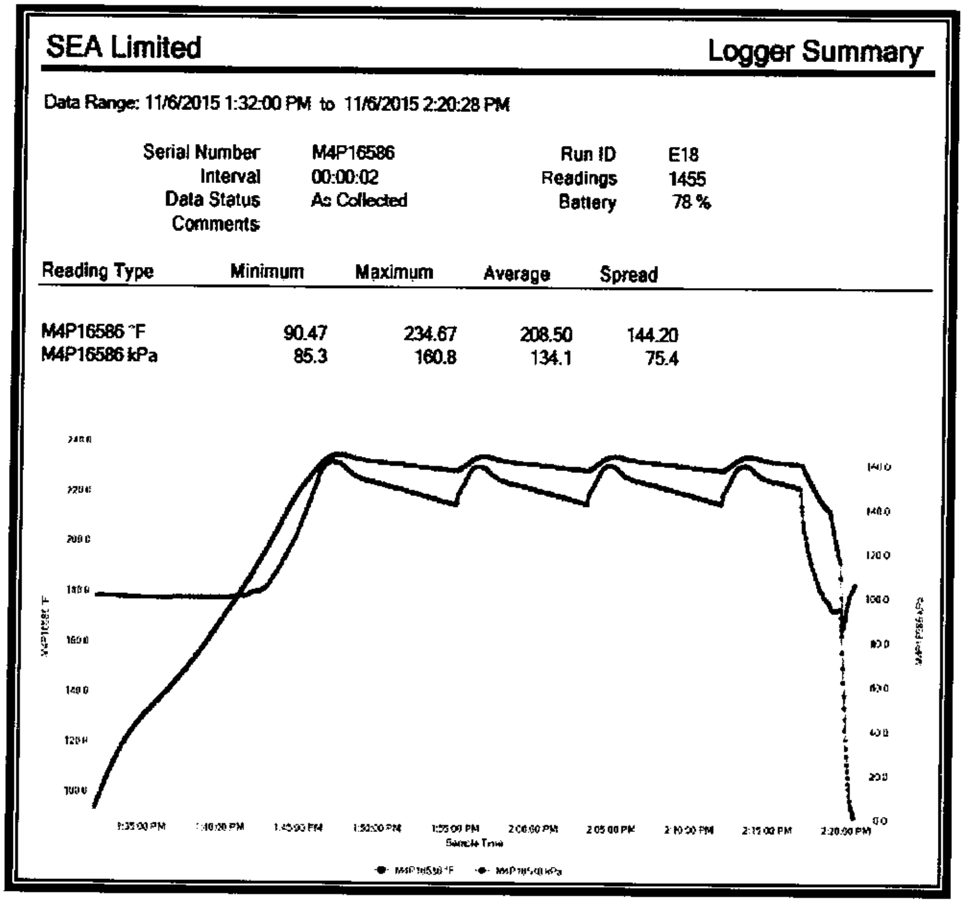


FIGURE 10: Example of data logger temperature (red) and pressure (blue) time series data.

For the remaining tests, the "Canning/Preserving" cook setting was chosen because it has the highest cook pressure, 83 kPa, of all cook settings as listed in the owner's manual. The default cook time for this program is 10 minutes for the "Quick" setting, 45 minutes for the "Medium" setting, and 2 hours for the "Well" setting. The cook time was manually adjusted according to the test matrix for each cook cycle using the "Time Adjustment" button.

The temperature and absolute pressure were recorded for each applicable test. The test measurements for each sample cooker are summarized in **Tables 8, 9, 10, and 11**. The initial temperature was recorded and typically ranged from about 70 °F to 108 °F. The initial absolute pressure typically ranged between 96 kPa and 101 kPa, which is approximately around 101 kPa (standard air pressure) for all tests. The maximum temperature and maximum absolute pressure were also measured. With this information, the temperature range for the test was calculated by subtracting the initial temperature from the maximum temperature. The pressure range was calculated by subtracting the initial absolute pressure from the maximum absolute pressure. The pressure range is meant to be a representative metric for the cook pressure setting on the control panel. The pressure range can also be thought of as the gauge pressure. For tests where the electronic mechanisms were disabled, the error codes and performance were documented in the absence of test measurements.

Test Number	Test Topic	Cook Setting	min Cook Time	kPa Cook Pressure	Test Description	hh:mm:ss Test Time	F Initial Temp	F Max Temp	F Temp Range	kPa Initial Pressure	kPa Max Pressure	kPa Pressure Range
1	Cook Cycle	Canning/Preserving	60	83	Normal cook cycle	1:44:08	75.01	243.50	168.49	97.2	190.8	93.6
2	Cook Cycle	Soup/Stew	60	50	Normal cook cycle	1:30:34	70.05	235.04	164.99	101.4	162.2	60.8
3	Cook Cycle	Slow Cook	60	---	Normal cook cycle	1:13:20	105.83	180.02	74.19	97.3	99.2	1.9
4	Cook Cycle	Beans/Lentils	30	50	Normal cook cycle	0:58:44	94.35	234.66	140.31	97.4	160.8	63.4
5	Cook Cycle	Rice/Risotto	25	50	Normal cook cycle	0:49:54	105.71	234.37	128.66	95.4	159.9	64.5
6	Cook Cycle	Fish/Vegetables Steam	10	50	Normal cook cycle	0:36:36	94.06	234.34	140.28	97.6	160.5	62.9
7	Cook Cycle	Chicken/Meat	60	50	Normal cook cycle	1:28:24	101.97	234.58	132.61	96.7	161.0	64.3
8	Cook Cycle	Keep Warm	30	---	Normal cook cycle	0:32:28	73.25	125.35	52.10	98.9	100.8	1.9
9	Cook Cycle	Canning/Preserving	60	83	Delay timer set to 30 minutes	2:06:08	108.03	241.75	133.72	95.8	181.3	85.5
10	Fill Level	Canning/Preserving	60	83	Max fill condition	1:47:36	93.58	241.40	147.82	95.9	179.8	83.9
11	Fill Level	Canning/Preserving	60	83	Minimum fill condition	1:23:28	102.44	244.74	142.30	94.3	195.0	100.7
12	Fill Level	Canning/Preserving	60	83	Empty condition - KEEP BELOW 280 F	0:51:04	79.87	216.91	137.04	99.7	102.2	2.5
13	Lid Lock	Canning/Preserving	60	83	Unlocked condition	0:31:36	68.98	210.73	141.75	101.1	105.1	4.0
14	Lid Lock	Canning/Preserving	60	83	Locked 5%	0:31:40	85.36	211.47	126.11	98.1	107.6	9.5
15	Lid Lock	Canning/Preserving	60	83	Locked 50%	0:36:12	95.81	211.58	115.77	97.3	104.0	6.7
16	Other	Canning/Preserving	60	83	Clog pressure release (PR) valve	1:36:20	83.76	245.07	161.31	96.8	193.8	97.0
17	Other	Canning/Preserving	60	83	Clog float valve in down position	1:35:28	72.82	244.58	171.76	99.7	189.8	90.1
18	Other	Canning/Preserving	0	83	Disable pressure sensor	DID NOT RUN - ERROR CODE E1						
19	Other	Canning/Preserving	0	83	Disable temperature sensor	DID NOT RUN - NO ERROR CODE						
20	Other	Canning/Preserving	0	83	Disable pressure/temp sensor	DID NOT RUN - ERROR CODE E4						

TABLE 8: Summary of test measurements for Sample J.

Test Number	Test Topic	Cook Setting	min Cook Time	kPa Cook Pressure	Test Description	hh:mm:ss Test Time	F Initial Temp	F Max Temp	F Temp Range	kPa Initial Pressure	kPa Max Pressure	kPa Pressure Range
1	Cook Cycle	Canning/Preserving	60	83	Normal cook cycle	1:46:04	79.26	245.05	165.79	99.1	190.0	90.9
2	Cook Cycle	Soup/Stew	60	50	Normal cook cycle	1:26:30	70.84	234.22	163.38	101.0	158.0	57.0
3	Cook Cycle	Slow Cook	60	---	Normal cook cycle	1:14:02	96.48	170.46	73.98	97.3	101.7	4.4
4	Cook Cycle	Beans/Lentils	30	50	Normal cook cycle	0:54:34	91.28	233.82	142.54	98.1	159.4	61.3
5	Cook Cycle	Rice/Risotto	25	50	Normal cook cycle	0:51:32	97.07	233.22	136.15	97.8	156.3	58.5
6	Cook Cycle	Fish/Vegetables Steam	10	50	Normal cook cycle	0:34:32	106.41	234.16	127.75	97.7	158.1	60.4
7	Cook Cycle	Chicken/Meat	60	50	Normal cook cycle	1:24:20	97.13	234.04	136.91	98.2	157.5	59.3
8	Cook Cycle	Keep Warm	30	---	Normal cook cycle	0:34:44	74.31	127.18	52.87	98.7	100.2	1.5
9	Cook Cycle	Canning/Preserving	60	83	Delay timer set to 30 minutes	2:11:30	71.60	244.19	172.59	99.1	188.5	89.4
10	Fill Level	Canning/Preserving	60	83	Max fill condition	1:51:08	90.23	244.02	153.79	96.2	187.9	91.7
11	Fill Level	Canning/Preserving	60	83	Minimum fill condition	1:26:06	98.90	246.70	147.80	96.9	200.6	103.7
12	Fill Level	Canning/Preserving	60	83	Empty condition - KEEP BELOW 280 F	1:04:36	71.77	229.48	157.71	99.0	102.2	3.2
13	Lid Lock	Canning/Preserving	60	83	Unlocked condition	0:33:48	73.81	209.97	136.16	98.3	102.2	3.9
14	Lid Lock	Canning/Preserving	60	83	Locked 5%	0:33:34	98.12	210.03	111.91	96.1	105.4	9.3
15	Lid Lock	Canning/Preserving	60	83	Locked 50%	0:32:48	95.54	210.66	115.12	97.0	103.5	6.5
16	Other	Canning/Preserving	60	83	Clog pressure release (PR) valve	1:37:26	74.11	242.85	168.74	99.9	184.8	84.9
17	Other	Canning/Preserving	60	83	Clog float valve in down position	1:32:36	71.68	245.82	174.14	100.4	194.5	94.1
18	Other	Canning/Preserving	0	83	Disable pressure sensor	DID NOT RUN - ERROR CODE E1						
19	Other	Canning/Preserving	0	83	Disable temperature sensor	DID NOT RUN - NO ERROR CODE						
20	Other	Canning/Preserving	0	83	Disable pressure/temp sensor	DID NOT RUN - ERROR CODE E4						

TABLE 9: Summary of test measurements for Sample K.

Test Number	Test Topic	Cook Setting	min Cook Time	kPa Cook Pressure	Test Description	hh:mm:ss Test Time	F Initial Temp	F Max Temp	F Temp Range	kPa Initial Pressure	kPa Max Pressure	kPa Pressure Range
1	Cook Cycle	Canning/Preserving	60	83	Normal cook cycle	1:38:18	72.59	244.65	172.06	101.0	189.9	88.9
2	Cook Cycle	Soup/Stew	60	50	Normal cook cycle	1:27:36	101.14	235.18	134.04	98.2	159.5	61.3
3	Cook Cycle	Slow Cook	60	---	Normal cook cycle	1:09:56	94.93	155.26	60.33	98.5	101.0	2.5
4	Cook Cycle	Beans/Lentils	30	50	Normal cook cycle	0:58:06	88.27	235.38	147.11	98.0	160.0	62.0
5	Cook Cycle	Rice/Risotto	25	50	Normal cook cycle	0:59:08	102.68	235.55	132.87	96.8	160.5	63.7
6	Cook Cycle	Fish/Vegetables Steam	10	50	Normal cook cycle	0:38:20	74.18	233.80	159.62	99.6	156.5	56.9
7	Cook Cycle	Chicken/Meat	60	50	Normal cook cycle	1:25:18	90.98	232.92	141.94	97.6	154.0	56.4
8	Cook Cycle	Keep Warm	30	---	Normal cook cycle	0:30:56	94.98	127.79	32.81	96.5	99.3	2.8
9	Cook Cycle	Canning/Preserving	60	83	Delay timer set to 30 minutes	2:06:00	86.24	246.24	160.00	96.5	197.0	100.5
10	Fill Level	Canning/Preserving	60	83	Max fill condition	1:46:42	103.63	243.25	139.62	95.3	184.3	89.0
11	Fill Level	Canning/Preserving	60	83	Minimum fill condition	1:26:56	73.91	247.69	173.78	98.6	206.7	108.1
12	Fill Level	Canning/Preserving	60	83	Empty condition - KEEP BELOW 280 F	0:51:04	106.61	239.05	132.44	98.1	103.1	5.0
13	Lid Lock	Canning/Preserving	60	83	Unlocked condition	0:34:56	83.79	210.05	126.26	95.7	102.8	7.1
14	Lid Lock	Canning/Preserving	60	83	Locked 5%	0:32:00	90.36	209.99	119.63	96.6	106.4	9.8
15	Lid Lock	Canning/Preserving	60	83	Locked 50%	0:36:28	74.06	210.33	136.27	98.6	105.6	7.0
16	Other	Canning/Preserving	60	83	Clog pressure release (PR) valve	1:36:32	85.68	242.90	157.22	96.3	184.4	88.1
17	Other	Canning/Preserving	60	83	Clog float valve in down position	1:38:04	86.68	244.12	157.44	96.3	188.8	92.5
18	Other	Canning/Preserving	0	83	Disable pressure sensor	DID NOT RUN - ERROR CODE E1						
19	Other	Canning/Preserving	0	83	Disable temperature sensor	DID NOT RUN - NO ERROR CODE						
20	Other	Canning/Preserving	0	83	Disable pressure/temp sensor	DID NOT RUN - ERROR CODE E4						

TABLE 10: Summary of test measurements for Sample L.

Test Number	Test Topic	Cook Setting	*min* Cook Time	*kPa* Cook Pressure	Test Description	*hh:mm:ss* Test Time	*F* Initial Temp	*F* Max Temp	*F* Temp Range	*kPa* Initial Pressure	*kPa* Max Pressure	*kPa* Pressure Range
1	Cook Cycle	Canning/Preserving	60	83	Normal cook cycle	1:39:08	73.15	244.72	171.57	100.9	189.5	88.6
2	Cook Cycle	Soup/Stew	60	50	Normal cook cycle	1:25:44	94.93	232.94	138.01	98.9	156.3	57.4
3	Cook Cycle	Slow Cook	60	---	Normal cook cycle	1:11:44	91.76	157.68	65.92	99.0	102.2	3.2
4	Cook Cycle	Beans/Lentils	30	50	Normal cook cycle	0:57:38	92.44	233.33	140.89	99.4	155.0	55.6
5	Cook Cycle	Rice/Risotto	25	50	Normal cook cycle	0:48:36	93.46	231.16	137.70	99.4	152.6	53.2
6	Cook Cycle	Fish/Vegetables Steam	10	50	Normal cook cycle	0:35:24	74.66	233.05	158.39	99.6	154.3	54.7
7	Cook Cycle	Chicken/Meat	60	50	Normal cook cycle	1:22:00	99.74	233.07	133.33	97.3	154.7	57.4
8	Cook Cycle	Keep Warm	30	---	Normal cook cycle	0:31:14	92.76	129.81	37.05	98.0	100.0	2.0
9	Cook Cycle	Canning/Preserving	60	83	Delay timer set to 30 minutes	2:08:20	84.78	243.62	158.84	98.4	187.2	88.8
10	Fill Level	Canning/Preserving	60	83	Max fill condition	1:43:10	73.31	242.52	169.21	98.7	183.5	84.8
11	Fill Level	Canning/Preserving	60	83	Minimum fill condition	1:26:28	94.88	246.67	151.79	96.4	202.7	106.3
12	Fill Level	Canning/Preserving	60	83	Empty condition - KEEP BELOW 280 F	0:51:04	99.30	212.99	113.69	100.4	103.0	2.6
13	Lid Lock	Canning/Preserving	60	83	Unlocked condition	0:37:16	83.19	210.09	126.90	97.2	106.6	9.4
14	Lid Lock	Canning/Preserving	60	83	Locked 5%	0:36:12	90.72	210.02	119.30	96.6	105.0	8.4
15	Lid Lock	Canning/Preserving	60	83	Locked 50%	0:39:52	73.72	210.86	137.14	98.8	104.5	5.7
16	Other	Canning/Preserving	60	83	Clog pressure release (PR) valve	1:39:28	77.56	241.41	163.85	98.2	183.2	85.0
17	Other	Canning/Preserving	60	83	Clog float valve in down position	1:37:32	86.26	243.21	156.95	97.1	184.9	87.8
18	Other	Canning/Preserving	0	83	Disable pressure sensor	DID NOT RUN - ERROR CODE E1						
19	Other	Canning/Preserving	0	83	Disable temperature sensor	DID NOT RUN - NO ERROR CODE						
20	Other	Canning/Preserving	0	83	Disable pressure/temp sensor	DID NOT RUN - ERROR CODE E4						

TABLE 11: Summary of test measurements for Sample M.

IV. DISCUSSION

PRESSURIZED LID REMOVAL TEST ANALYSIS

During the pre-test inspections, the lid locking tabs and outer pot locking tabs were evaluated for their ability to retain the lid to the cooker housing prior to operational testing. The lid on each cooker was locked, which engaged the lid locking tabs with the outer pot locking tabs. **Each cooker with a locked lid was picked off the ground using only the lid handle to verify that the lid could stay locked. All four cookers examined during this inspection were capable of lifting the locked cooker off the ground using only the lid handle.**

Lid removal tests were performed in order to test the ability of the pressure cooker locking mechanisms to function effectively and evaluate the possibility of an operator opening the lid of a pressurized cooker. The lid removal tests were performed with three separate lid positions: fully locked (100%), half locked (50%), and barely locked (5%). The percentages are merely indicative of the general locking positions and not exact figures. The exemplar cooker was brought to full operating pressure, at which time the power was shut off to the cooker. Without power, the cooker no longer supplied heat to the inner pot and the internal pressure decreased. At regular pressure intervals, a lid torque (about 60 in-lb) was applied until the lid could be moved or removed completely. **Figure 12** shows a comparison of the absolute pressure plots for the fully locked (100%), half-locked (50%), and barely locked conditions (5%).

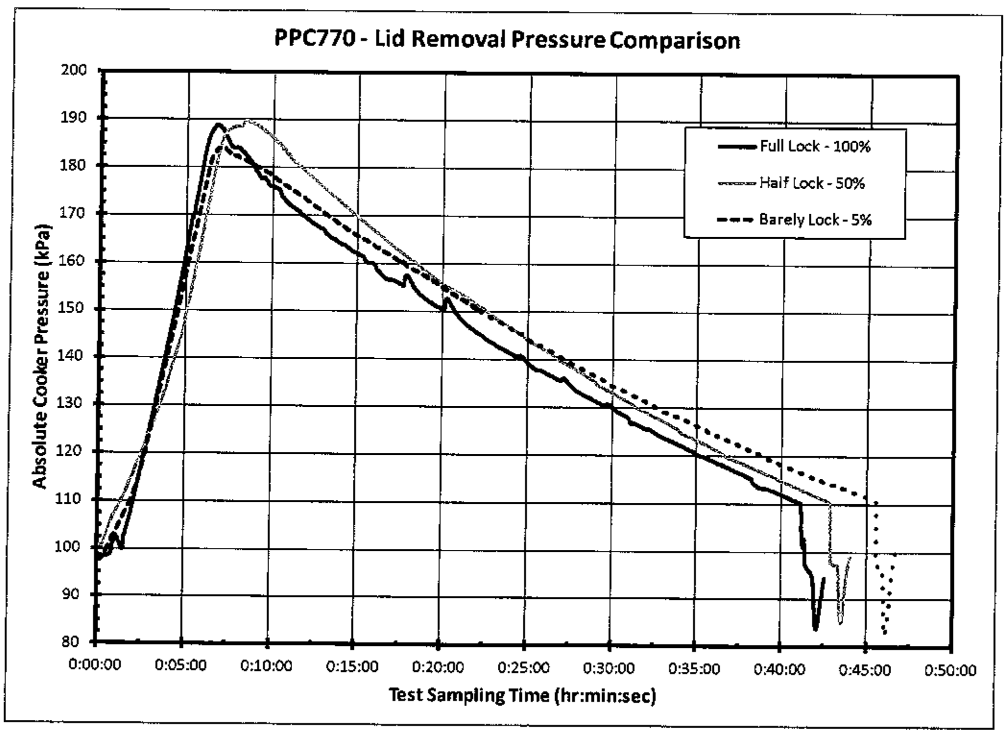


FIGURE 12: Comparison of the absolute pressure measurements for the lid removal tests with a fully locked, half-locked, and barely locked lid.

The float valve mechanism is designed to prevent the lid from rotating and fully unlocking. With the lid fully locked, the float valve would elevate at operational pressure and engage the through hole in the lid, preventing full lid rotation. During the lid removal test for the fully locked position, the ability to slightly rotate the lid was monitored for each torque application. The applied torque began to rotate the lid at 110 kPa, at which time the float valve was manually depressed and the lid was removed.

The performance of the cookers was similar for the lid removal tests. All three cookers had a maximum pressure that ranged from 184 kPa to 190 kPa. From Figure 12, it is clear that the pressure when the lid is moved or removed is substantially lower than the full operating pressure. This is illustrated by a steep vertical drop off in the pressure plots at values around 110 kPa on the right side of the plot. This equates to an approximate reduction of cooker pressure of around 90% when comparing the maximum pressures (190 kPa), the lid removal pressures (110 kPa), and the atmospheric pressure (101 kPa). Figure 12 also illustrates that after reaching full operating pressure, the cookers do not reach a pressure at which the lids can be forcibly removed for a length of time. The time ranged from approximately 30 to 40 minutes from when the maximum pressure occurred to when the lids could be forcibly removed.

The individual removal pressures for all three locking conditions were similar. The data shows that the lid was removed at a pressure of 110.4 kPa for the barely locked condition and 109.5 kPa for the half-locked condition. The applied torque began moving the lid at a pressure of 110.2 kPa for the fully locked condition. The average pressure at which the lid was removed was 110.0 kPa. This value corresponds to a gauge pressure of 9.0 kPa (1.3 psi) assuming that atmospheric pressure is 101 kPa. The inner side of the lid is exposed to this pressure when the lid is removed, thus a vertical force is applied to the lid at the time of removal. The projected lid area that the pressure is applied to has a diameter of approximately 8.7 inches, which results in a projected lid area of 59.4 in^2. The weight of the lid is about 1.0 kg (2.2 pounds) and opposes the upward pressure on the lid. Using the average gauge pressure when the lid is removed of 9.0 kPa (1.3 psi) and subtracting the weight of the lid, the calculated vertical load on the lid when it is removed is 335 N (75.3 pounds).

While the magnitude of force on the lid may seem difficult to control, this force quickly dissipates as the pressure is released to the surrounding atmosphere when the lid is opened. The measuring equipment could only sample at a rate of 1 sample every 2 seconds. The force impulse on the lid created by the internal pressure is significantly shorter than 2 seconds given how quickly the internal pressure can equalize with the ambient air pressure. Using the measurements listed previously for the cooker, S-E-A calculated the max height the lid would be ejected versus the length of time for the force impulse (in milliseconds) on the lid using an average lid removal gauge pressure of 9.0 kPa (**Table 12**). The calculations in Table 12 take gravity into effect. The calculations also assume that the initial lid force uniformly decreases to 0 over the length of the impulse and there is no force resisting the lid motion during the impulse besides gravity (the lid is untouched by the user). **The calculations show that the lid velocity due to the release of internal pressure may be as high as 16.0 feet per second (10.9 mph),** which is similar to the typical pitched-ball speed for the game of slow-pitch softball. The maximum ejected lid height ranges from 5.6 inches to 50.5 inches depending on the

length of the impulse and assuming that no opposing lid force is applied by the operator during lid removal. Any forces exerted by an operator before, during, or after the disengagement of the locking tabs would have a significant effect on the motion of the lid under such circumstances.

Force Impulse Duration *(ms)*	Ejected Lid Velocity *(ft/s)*	Maximum Ejected Lid Height *(ft)*	Maximum Ejected Lid Height *(in)*
10	5.3	0.5	5.6
15	8.0	1.1	12.6
20	10.7	1.9	22.4
25	13.3	2.9	35.1
30	16.0	4.2	50.5

TABLE 12: Calculated lid ejection height versus internal lid force impulse time.

During the lid removal tests, the test technician was actively forcing the lid open. During this process, the test technician was holding the lid using the lid handle. When the lid was removed and began to move upward, the motion was opposed by the grip of the test technician. Additional tests were made in order to estimate the potential resistive force applied by the test technician's hand to the lid. Using a digital scale, the resting weight of the technician's hand was determined to be around 3 pounds. The test technician was then asked to use his hand to push on the scale, using only his arm and shoulder strength, and apply a reasonable amount of force. After repeated trials, it was determined that the technician could apply around 15 pounds of downward force to the scale. Lastly, the technician was asked to apply a maximum amount of force to the scale. Test results showed that the maximum amount of vertical force the technician could apply using his arm and shoulder was around 40 pounds. These values can be used to estimate the amount of downward force the technician could apply to the lid in order to oppose the upward ejection of the lid after pressurized removal.

An analysis was performed to calculate the maximum height the lid would travel while the test technician was applying an opposing force to the lid handle. In this analysis, the operator is essentially trying to arrest the vertical velocity and motion of the lid by maintaining a grip on the lid handle. The results of the calculations showing the effect of the applied opposing lid force on the lid ejection height are shown in **Table 13** for a 30 ms, 20 ms, and 10 ms force impulse. To be conservative, the calculations assume that the opposing lid force is applied after the pressure force impulse is completed. This analysis also assumes that the operator is capable of applying a constant opposing force over the duration of the lid ejection. The calculations show that 15 pounds of downward force applied to the lid would produce a resulting maximum lid ejection height up to 9 inches for a force impulse that is less than 30 milliseconds. This is aligned with the observed vertical lid displacements of less than 6 inches during the lid removal tests. **In all three lid removal tests, the test technician was able to maintain control of the lid despite the intentional misuse.**

Applied Opposing Lid Force *(lbs)*	Maximum Ejected Lid Height *(in, 30 ms pulse)*	Maximum Ejected Lid Height *(in, 20 ms pulse)*	Maximum Ejected Lid Height *(in, 10 ms pulse)*
3	23.0	10.2	2.6
10	11.5	5.1	1.3
15	9.0	4.0	1.0
20	7.6	3.4	0.8
30	6.1	2.7	0.7
40	5.4	2.4	0.6

TABLE 13: Calculated lid ejection height versus opposing lid force.

The pressure cooker owner's manual contains multiple statements that describe instructions directing users not to force the lid open or open the cooker prior to full internal pressure release. In the "Important Safeguards" section on page 1, the manual states the following in regards to the potential hazards of pressure cooker:

> "Do not touch hot surfaces. Use handles or knobs."
>
> "Extreme caution must be used when moving an appliance containing hot oil or other hot liquids."
>
> "This appliance cooks under pressure. Improper use may result in scalding injury. Make certain the unit is properly closed before operating."
>
> "Overfilling may cause clogging, allowing excess pressure to develop."
>
> "The Power Pressure Cooker XL generates extreme heat and steam in its operation. All necessary precautions must be taken to avoid fire, burns and other personal injury during its operation."
>
> "CAUTION HOT SURFACES. This appliance generates heat and escaping steam during use. Proper precautions must be taken to prevent the risk of personal injury, fires, and damage to property."

The statements in the "Important Safeguards" section also address methods to properly and safely open the lid under various conditions:

> "Always open the lid away from you to avoid skin contact with any remaining heat or steam."
>
> "NEVER FORCE OPEN the Power Pressure Cooker XL. If you need to open the Power Pressure Cooker XL, press the "KEEP WARM/

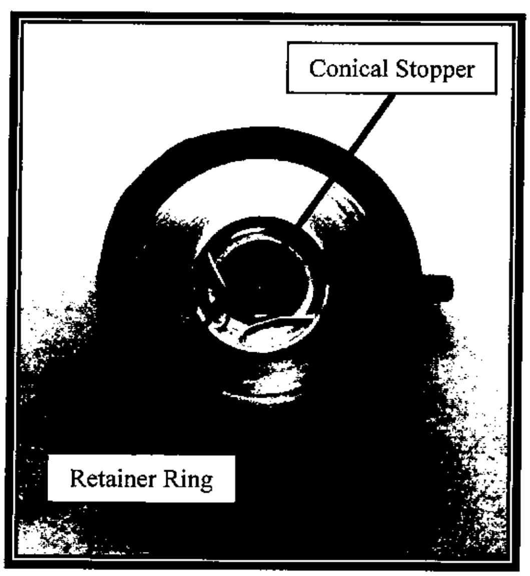
CANCEL" button and and using tongs or a kitchen tool carefully rotate the Pressure Valve to the OPEN position to full release the building pressure inside the cooker."

"Do not open the Power Pressure Cooker XL until the unit has cooled and all internal pressure has been released. If the unit is difficult to open, this indicates that the cooker is still pressurized – do not force it open. Any pressure in the cooker can be hazardous."

As the results of the lid removal tests have shown, the lid can be removed under partial pressure for certain conditions although the practice is not condoned by the owner's manual. The owner's manual does provide alternatives to avoid such an activity. By following the guidelines presented above, the test technician was able to maintain safe control of the lid for all lid removal tests.

OPERATIONAL EXAMINATION ANALYSIS

The pressure release valve is a critical assembly for the safe operation of the pressure cooker. It is composed of a weighted cap, retainer ring, conical stopper, and metal exhaust valve (**Figure 13**). The weighted cap rests on top of the metal exhaust valve. A conical stopper within the weighted cap seats into the exhaust valve vent hole, blocking the release of steam. There is also a retainer ring seated in the pressure release weighted cap. It normally retains the weighted cap to the metal exhaust valve. When the weighted cap and conical stopper elevate off of the metal exhaust valve, prior to the snap ring engaging the metal exhaust valve, venting will begin through the opening in the top of the weighted cap. The behavior results in an immediate decrease of internal pressure that prevents further pressure increases.



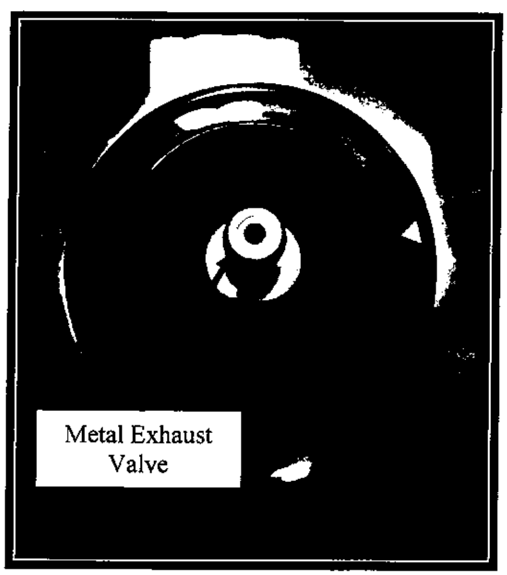


FIGURE 13: Photographs showing the weighted cap, retainer ring, and conical stopper (left) and the pressure release metal exhaust valve (right).

Measurements of the various pressure release valve component dimensions were made to calculate the cooker pressure required to lift the pressure release weighted cap off of the exhaust valve and vent the steam. The average weights of the pressure release weighted caps for all inspected pressure cookers was 93 grams. The metal exhaust valve also had similar dimensions for all cookers with an average inside diameter measuring around 2.75 mm and an average outside diameter measuring around 9.64 mm. Assuming the conical stopper sealed the metal exhaust valve and given the average mass of the weighted cap (93 grams) and the average inside diameter of the pressure release metal exhaust valve (2.75 mm), **S-E-A calculated that it would take an internal absolute pressure of 254 kPa (36.9 psi) to lift the weighted cap off of the exhaust valve, at which point the internal pressure would be relieved and vented in a controlled manner per normal operation.** In other words, once the gauge pressure (pressure range) inside the cooker reaches 153 kPa (22.3 psi) or 184% of the maximum cook pressure setting (83 kPa), venting will begin, which makes it difficult to continue to develop additional pressure within the cooker.

The maximum gauge pressure (pressure range) was calculated for all 72 operational tests performed on the four sample pressure cookers. The maximum gauge pressure was calculated by subtracting the initial absolute pressure in the cooker (approximately atmospheric pressure) at the beginning of the test from the maximum absolute pressure for the entire test. The values of the gauge pressure (pressure range) for all tests on each sample are shown in **Table 14**. The pressure range test results in Table 14 reveal that the average max pressure range for the cook cycle tests, excluding the "Low Temp Cook" and "Keep Warm" tests, was 72.9 kPa (10.6 psi) and the average pressure range was 68.5 kPa (9.9 psi). The maximum gauge pressure for all measurements was 108.1 kPa (15.7 psi) which occurred on Sample L during the minimum fill condition test, number 11. This test exhibited the largest pressure readings among all tests. The average of the pressure ranges for all four cookers for test number 11 was 104.7 kPa (15.2 psi), with a standard deviation of 3.2 kPa (0.46 psi). **Statistical analysis of the test data shows that the pressure required to lift the weighted cap, venting the internal pressure, is 15 standard deviations above the average of the maximum observed pressures.**

A one-tailed Student's t-test was performed to determine the odds of a pressure cooker reaching a gauge pressure of 153 kPa based on the measurements of four exemplar cookers subjected to the minimum fill condition test number 11. A Student's t-test is a statistical test that assesses the characteristics of a large population based on a limited number of test samples. The t-test results show that the odds of a pressure cooker reaching a gauge pressure of 153 kPa is only 1 out of every 12,283 cookers, and at this point, the pressure release valve would lift and vent steam to ensure the pressure does not become excessive. Based on the statistical analysis of the test results, only 81 out of 1 million pressure cookers would potentially reach a gauge pressure large enough to cause the pressure release weighted cap to vent steam. It is important to note that this calculation is only viable if the internal pressure regulating mechanism is not functioning correctly because the redundant mechanism would reduce the heat input to the cooker inner pot helping prevent the pressure from reaching 153 kPa. Also, the Student's t-test is dependent on the number of test samples. If 6 samples were tested instead of 4, while maintaining the same mean and standard deviation for the samples, the odds of reaching a gauge pressure of 153 kPa for the minimum fill condition would have been 1 out of 3.5 million pressure cookers.

TEST DATA SUMMARY - GAUGE PRESSURE (PRESSURE RANGE)					Sample	J	K	L	M			
Test Number	Test Topic	Cook Setting	*min* Cook Time	*kPa* Cook Pressure	Test Description	*kPa* Pressure Range	*kPa* Pressure Range	*kPa* Pressure Range	*kPa* Pressure Range	*kPa* Max	*kPa* Min	*kPa* Range
1	Cook Cycle	Canning/Preserving	60	83	Normal cook cycle	93.6	90.9	88.9	88.6	93.6	88.6	5.0
2	Cook Cycle	Soup/Stew	60	50	Normal cook cycle	60.8	57.0	61.3	57.4	61.3	57.0	4.3
3	Cook Cycle	Slow Cook	60	---	Normal cook cycle	1.9	4.4	2.5	3.2	4.4	1.9	2.5
4	Cook Cycle	Beans/Lentils	30	50	Normal cook cycle	63.4	61.3	62.0	55.6	63.4	55.6	7.8
5	Cook Cycle	Rice/Risotto	25	50	Normal cook cycle	64.5	58.5	63.7	53.2	64.5	53.2	11.3
6	Cook Cycle	Fish/Vegetables Steam	10	50	Normal cook cycle	62.9	60.4	56.9	54.7	62.9	54.7	8.2
7	Cook Cycle	Chicken/Meat	60	50	Normal cook cycle	64.3	59.3	56.4	57.4	64.3	56.4	7.9
8	Cook Cycle	Keep Warm	30	---	Normal cook cycle	1.9	1.5	2.8	2.0	2.8	1.5	1.3
9	Cook Cycle	Canning/Preserving	60	83	Delay timer set to 30 minutes	85.5	89.4	100.5	88.8	100.5	85.5	15.0
10	Fill Level	Canning/Preserving	60	83	Max fill condition	83.9	91.7	89.0	84.8	91.7	83.9	7.8
11	Fill Level	Canning/Preserving	60	83	Minimum fill condition	100.7	103.7	108.1	106.3	108.1	100.7	7.4
12	Fill Level	Canning/Preserving	60	83	Empty condition - KEEP BELOW 280 F	2.5	3.2	5.0	2.6	5.0	2.5	2.5
13	Lid Lock	Canning/Preserving	60	83	Unlocked condition	4.0	3.9	7.1	9.4	9.4	3.9	5.5
14	Lid Lock	Canning/Preserving	60	83	Locked 5%	9.5	9.3	9.8	8.4	9.8	8.4	1.4
15	Lid Lock	Canning/Preserving	60	83	Locked 50%	6.7	6.5	7.0	5.7	7.0	5.7	1.3
16	Other	Canning/Preserving	60	83	Clog pressure release (PR) valve	97.0	84.9	88.1	85.0	97.0	84.9	12.1
17	Other	Canning/Preserving	60	83	Clog float valve in down position	90.1	94.1	92.5	87.8	94.1	87.8	6.3

TABLE 14: Summary of values of the gauge pressure (pressure range) for all tests.

The force required to remove the pressure release weighted cap from the lid was measured. A spring scale was attached to the component and was quasi-statically lifted upwards until the snap ring force was overcome, removing the weighted cap from the pressure release metal exhaust valve. Repeated measurements were taken on each cooker to determine the force required to detach the component. Of the approximately 40 total measurements taken during the inspection of the four cookers, the force required to detach the weighted cap from the metal exhaust valve ranged from a minimum of 18.2 N (4.1 lbs) to a maximum of 24.9 N (5.6 lbs). **Based on these measurements, an upward force of at least 18.2 N (4.1 pounds) is necessary to dislodge the weighted cap from its retainer ring. The correlating internal absolute pressure of 3,155 kPa (458 psi) would not be expected to be developed given that the maximum measured absolute pressure for all tests was 206.7 kPa and that the weighted cap would normally begin venting at about 254 kPa as discussed previously.**

The measured values for maximum pressure cooker temperature for all tests on each sample are shown in **Table 15**. The table shows that the maximum temperature for all measurements was 247.69 degrees Fahrenheit (°F), which occurred on Sample L during the minimum fill condition test, number 11. The average of the maximum temperatures for all four cookers for test number 11 was 246.45 °F, with a standard deviation of 1.23 °F. Although this test exhibited the largest temperature readings among all tests, the temperature readings for other tests using the "Canning/Preserving" cook function demonstrated similar maximum temperatures. For the tests that were capable of building to full operational pressure using the "Canning/Preserving" setting, the average maximum temperature was 244.19 °F, very similar to test 11 which had a average maximum temperature of 246.45 °F. The temperature performance for this cook setting was consistent with a standard deviation of 1.85 °F or less for this type of test utilizing the "Canning/Preserving" cook setting and achieving operational pressure.

The average maximum temperature for all cook cycle tests, excluding the "Slow Cook" and "Keep Warm" tests, was 238.05 °F. The "Slow Cook" had an average maximum temperature of 165.86 °F. The "Keep Warm" cook cycle setting had an average maximum temperature of 127.53 °F, the lowest reading among all the tests performed on the PPC770 cookers. Both the "Slow Cook" and "Keep Warm" cook cycles could not generate enough heat to produce any substantial pressure increases in the cooker during any of the tests.

TEST DATA SUMMARY - MAXIMUM TEMPERATURE					Sample	J	K	L	M			
Test Number	Test Topic	Cook Setting	*min* Cook Time	*kPa* Cook Pressure	Test Description	*F* Max Temp	*F* Max Temp	*F* Max Temp	*F* Max Temp	*F* Max	*F* Min	*F* Range
1	Cook Cycle	Canning/Preserving	60	83	Normal cook cycle	243.50	245.05	244.65	244.72	245.05	243.50	1.55
2	Cook Cycle	Soup/Stew	60	50	Normal cook cycle	235.04	234.22	235.18	232.94	235.18	232.94	2.24
3	Cook Cycle	Slow Cook	60	---	Normal cook cycle	180.02	170.46	155.26	157.68	180.02	155.26	24.76
4	Cook Cycle	Beans/Lentils	30	50	Normal cook cycle	234.66	233.82	235.38	233.33	235.38	233.33	2.05
5	Cook Cycle	Rice/Risotto	25	50	Normal cook cycle	234.37	233.22	235.55	231.16	235.55	231.16	4.39
6	Cook Cycle	Fish/Vegetables Steam	10	50	Normal cook cycle	234.34	234.16	233.80	233.05	234.34	233.05	1.29
7	Cook Cycle	Chicken/Meat	60	50	Normal cook cycle	234.58	234.04	232.92	233.07	234.58	232.92	1.66
8	Cook Cycle	Keep Warm	30	---	Normal cook cycle	125.35	127.18	127.79	129.81	129.81	125.35	4.46
9	Cook Cycle	Canning/Preserving	60	83	Delay timer set to 30 minutes	241.75	244.19	246.24	243.62	246.24	241.75	4.49
10	Fill Level	Canning/Preserving	60	83	Max fill condition	241.40	244.02	243.25	242.52	244.02	241.40	2.62
11	Fill Level	Canning/Preserving	60	83	Minimum fill condition	244.74	246.70	247.69	246.67	247.69	244.74	2.95
12	Fill Level	Canning/Preserving	60	83	Empty condition - KEEP BELOW 280 F	216.91	229.48	239.05	212.99	239.05	212.99	26.06
13	Lid Lock	Canning/Preserving	60	83	Unlocked condition	210.73	209.97	210.05	210.09	210.73	209.97	0.76
14	Lid Lock	Canning/Preserving	60	83	Locked 5%	211.47	210.03	209.99	210.02	211.47	209.99	1.48
15	Lid Lock	Canning/Preserving	60	83	Locked 50%	211.58	210.66	210.33	210.86	211.58	210.33	1.25
16	Other	Canning/Preserving	60	83	Clog pressure release (PR) valve	245.07	242.85	242.90	241.41	245.07	241.41	3.66
17	Other	Canning/Preserving	60	83	Clog float valve in down position	244.58	245.82	244.12	243.21	245.82	243.21	2.61

TABLE 15: Summary of values of the maximum temperature for all tests.

FLUID FILL LEVEL ANALYSIS

Multiple tests were performed to evaluate the response of the cooker to the level of fluid within the inner pot of the cooker. The inner pot has graduated lines imprinted on the inside surface of the pot that indicate the various fill levels in "1/5" increments from a minimum level of "2" to a maximum fill level of "4/5", as shown in **Figure 14**.

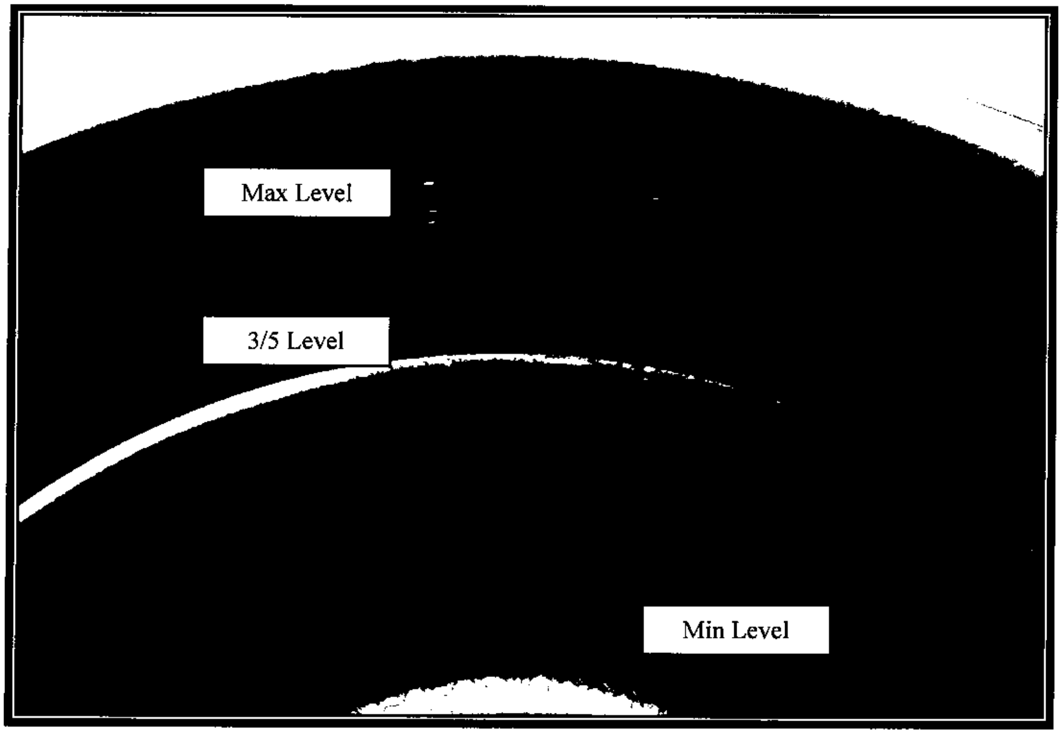


FIGURE 14: Fill level graduation marks on the inner pot of the pressure cooker.

There were four fluid levels evaluated during testing: maximum fill (4/5), 3/5 fill, minimum fill (2), and empty. As mentioned previously, the minimum condition fill test (number 11) exhibited the highest maximum temperatures, averaging around 246.5 °F. The average maximum temperatures for the other fill level conditions were all very similar, ranging from 224.6 °F for the empty condition to 242.8 °F for the maximum fill condition. The pressure results for the fill condition tests are compared in **Figure 15**. Figure 15 shows the minimum (2) fill condition, the 3/5 fill condition, and the maximum (4/5) fill condition pressure plots for all four exemplar cookers. **The minimum fill condition has the shortest pressurization times, as well as the highest maximum pressures compared with the higher and lower fill levels.** The average maximum absolute pressure for the minimum fill condition is 201.3 kPa. The average maximum absolute pressure for the 3/5 fill condition is 190.1 kPa. The average maximum absolute pressure for the maximum fill condition is 183.9 kPa, the lowest of the three tests plotted.

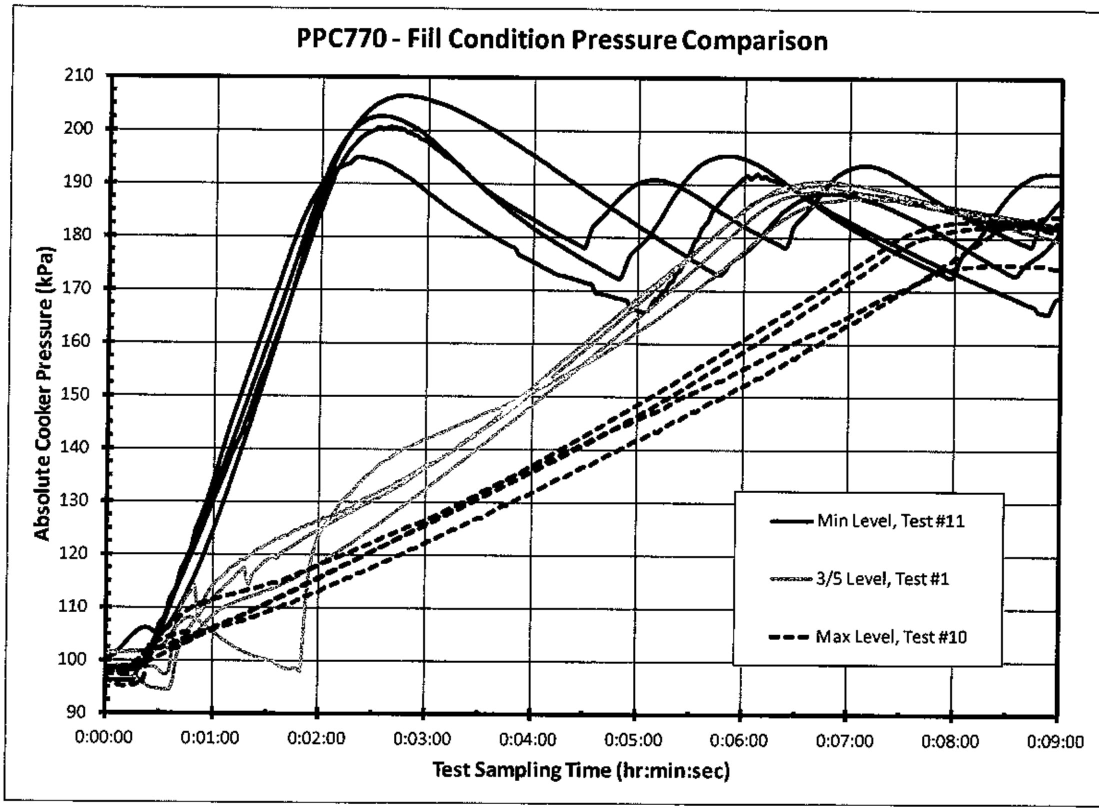


FIGURE 15: Comparison of the absolute pressure measurements by fill condition.

The maximum fill condition takes the longest time to reach full pressurization. This is due to the increased volume of water that needs a greater amount of heat to reach its boiling point. Once the water approaches its boiling point, the pressure in the cooker begins to increase. As the pressure increases, there is a correlating increase in the temperature and boiling point of the water. The minimum fill condition heats the fastest because it contains the smallest volume of water of the three tests, thus, the water can be heated faster than the other two conditions. The heat is regulated by an internal pressure sensor that will shut off the heat to the inner pot when a threshold pressure is reached. While this sensor can modulate the heat input to the inner pot, there is still residual pressure produced once the heat is shut off by the pressure sensor as the water continues to boil until it can cool. This can result in the pressure in the cooker continuing to increase over the short term, overshooting the nominal pressure target set by the user depending on how quickly the pressure is building in the cooker. Since the minimum fill condition heats and pressurizes the fastest, it results in a greater pressure overshoot and the highest measured pressures of the three conditions.

LID LOCKING POSITION ANALYSIS

The performance of the lid locking mechanism was evaluated by varying the lid position in multiple intervals between the locked and unlocked positions. When the lid is placed on the top of the cooker housing, it is secured by rotating the lid counterclockwise. The rotation positions the lid locking tabs so that they can engage the outer pot locking tabs

when the cooker becomes pressurized, which restrains the lid to the cooker housing during operation. For this test series, locking the lid is defined as having some portion of engagement between the lid and outer pot locking tabs. The four lid locking positions included unlocked, barely locked (5%), half-locked (50%), and fully locked (100%). Figure 9 shows the relative locking positions for this tests series. The percentages are merely used as approximations of the locking positions and are not representative of exact positions. The fully locked condition is represented by test number 1 and experiences a normal operating response as indicated previously. The average pressure range for the fully locked position test on the four exemplars was 90.5 kPa, the average maximum pressure was 190.1 kPa, and the average max temperature was 244.48 °F.

There is a slider with a through hole in the lid that is aligned with the float valve when the lid is either in the locked or unlocked position (Figure 4). The float valve is designed to elevate when pressure builds in the cooker. The vertical translation of the float valve engages a slider hole in the outer lid, which normally prevents the lid from rotating and unlocking until the pressure has been released. When the lid is at an intermittent locking position between fully locked and unlocked, the slider normally prevents the valve from fully elevating and allows the float valve to vent steam during operation. The float valve mechanism should normally prevent the pressure within the cooker from significantly increasing because the float valve is slowly venting steam due to interference with the slider.

In the unlocked position, there is no engagement between the lid locking tabs and the outer pot locking tabs, therefore, the lid is not restrained to the cooker. When the water inside the pot begins boiling, steam is created and the pressure begins slowly leaking through the lid gasket because there is no force holding the lid in place. This slow pressure leakage prevents the cooker from building any significant pressure within the cooker. This is shown in the test results where the average pressure range for the unlocked condition test (test number 13) is 6.1 kPa and the average maximum pressure is 104.2 kPa, similar to ambient air pressure. The average maximum temperature during the unlocked test is 210.21 °F and does not increase past boiling (about 212 °F for water) because the pressure within the cooker cannot significantly increase.

The performance of the lid in the barely locked (5%) and half-locked (50%) positions is similar to that of the unlocked position. Although the lid is restrained by the locking tabs in these tests, the float valve is prevented from elevating by the slider in the lid and continuously leaks pressure and steam. The leakage prevents the cooker from building significant pressure and temperatures above the boiling point of water. This is shown in the test results where the average pressure range for the barely locked condition test (test number 14) is 9.3 kPa and the average maximum pressure is 106.1 kPa. The average maximum temperature for this test is 210.38 °F. The average pressure range for the half-locked condition test (test number 15) is 6.5 kPa and the average maximum pressure is 104.4 kPa. The average maximum temperature during this test is 210.86 °F. **The pressure and temperature measurements for the unlocked and partially locked lid position tests are similar to one another and show that the internal pressures remain near the ambient air pressure.**

S-E-A evaluated the possibility that the lid may rotate toward the unlocked position on its own during operation. This idea is unsupported, though, as shown by the lid removal

tests and the lid locking position tests. If the lid was capable of coming off during pressurization, then the barely locked position would be prone to issues because the lid would only have to rotate through a small angle in order to be ejected. This behavior was disproven during the tests with the lid in the barely locked position because the lid was secured throughout the entire duration of every lid locking test. In addition, the lid removal tests showed that if the lid is barely locked, it would still take a reasonable amount of lid torque by the user to forcibly dislodge the lid on a pressurized cooker. These tests results show that the lid was not forced open by internal pressure even when it was not completely locked.

While every lid removal and locking position test showed that the lid would remain secure at full operational pressure, there still may be some concern regarding the angle of the locking tabs generating a horizontal/circumferential force which would be capable of dislodging and ejecting the lid. In order for this to happen, the circumferential force would have to overcome the force of friction between the lid and outer pot locking tabs produced by the internal pressure of the cooker. As the internal pressure increases, the frictional force also increases. This requires a much larger circumferential locking tab force to overcome the increased frictional force from the larger internal pressures.

Calculations on the internal pressure, locking tab friction, locking tab circumferential angle, and the lid ejection force were performed in order to evaluate the potential of the lid becoming dislodged and ejected during operation. The circumferential ejection force increases as the angle of the locking tab from horizontal increases. The largest circumferential locking tab angle measurement on the four samples was 0.90 degrees from horizontal. **Figure 16** shows an example of measuring the locking tab circumferential angle from horizontal. The average circumferential locking tab angle measurement for all four samples was 0.61 degrees. The force generated on each of the six locking tabs is a result of the internal pressure pushing on the underside of the lid. The projected lid area that the pressure is applied to has a diameter of approximately 8.7 inches, which results in a projected lid area of 59.4 in^2. The maximum internal pressure range, or cook pressure, for all tests was 108.1 kPa (15.7 psi) occurring on the minimum fill level test for Sample L. Multiplying the maximum pressure range by the projected lid area yields a vertical force on the lid of 932.6 pounds. The weight of the lid is about 1.0 kg (2.2 pounds) and opposes the upward force on the lid and must be subtracted from the vertical force. The resulting net vertical upward force on the lid was 930.4 pounds for the maximum pressure range measured across all tests. This vertical lid force is opposed by the six locking tabs, which restrain the lid to the outer pot during operation. Assuming that the vertical force is distributed equally among the six locking tabs, each individual locking tab would be subjected to 155.1 pounds of vertical load. Breaking the total vertical force (930.4 pounds) into components related to the 0.9 degree locking tab yields a total normal force of 930.3 pounds and a total circumferential (planar) locking tab force of 14.6 pounds. Assuming a friction coefficient between the metal lid locking tabs and the metal outer pot locking tabs of 0.15, the total circumferential frictional force is calculated as 139.5 pounds. The calculations show that the total circumferential locking tab force (14.6 pounds) is significantly less than the total locking tab frictional force (139.5 pounds), **meaning that the locking tab angles are not steep enough for the lid to become dislodged and ejected when the cooker is fully pressurized without additional external torque applied to the lid.** Using the same calculation methods, all the cooker locking tabs would have to have a circumferential angle greater than 8.6

degrees for the lid to become dislodged on its own, which is much greater than the maximum measured locking tab angle of 0.90 degrees and the average angle of 0.61 degrees. **The tests and calculations show that a lid will not rotate toward an unlocked position and come off a pressure cooker on its own if the cooker is fully pressurized and the lid and outer pot locking tabs are engaged, regardless of lid locking position.**

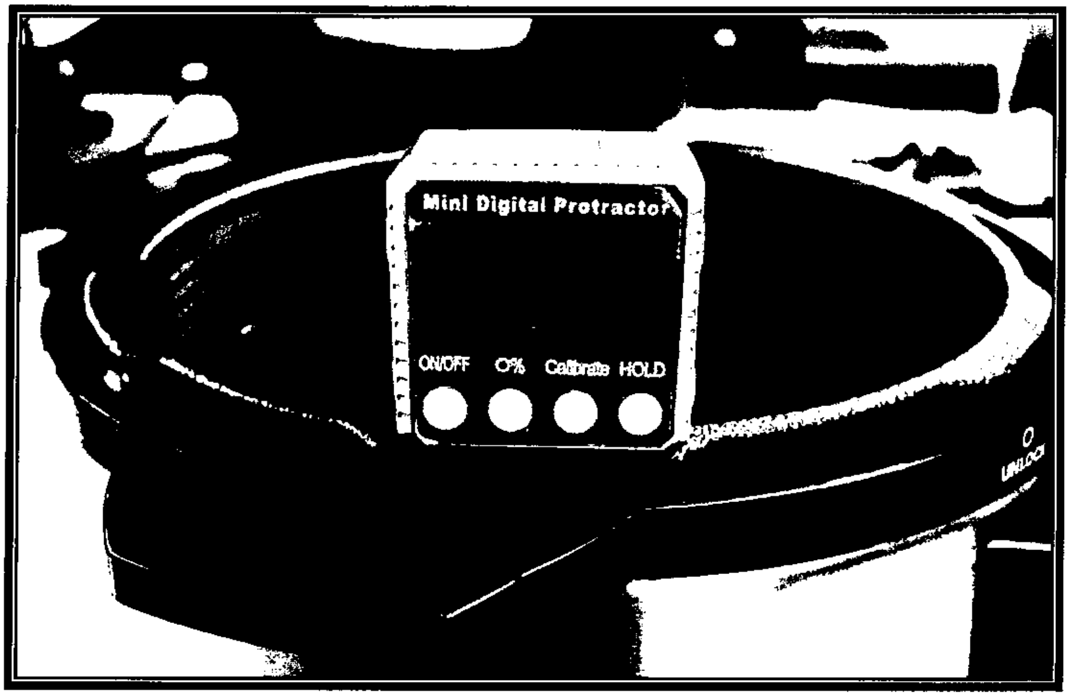


FIGURE 16: Example of circumferential outer pot locking tab angle measurement.

If we compare the previous calculations to the pressurized lid removal test results, we can estimate the torque applied by the test technician to forcibly open the lid at a lower internal pressure. The average gauge pressure at which the lid could be forced open was 9.0 kPa (1.3 psi). Multiplying this by the projected area of the lid (59.4 in2) and subtracting the approximate weight of the lid (2.2 pounds) yields a resultant vertical force of 75.3 pounds on the underside of the lid. This results in a vertical force of 12.6 pounds supported by each of the six locking tabs. Converting this force into components using a locking tab average circumferential angle of 0.61 degrees, the calculated normal force is 12.6 pounds and the circumferential force is 0.13 pounds. Multiplying the normal force by an assumed friction coefficient of 0.15, the calculated locking tab frictional force is 1.9 pounds. The difference between the frictional force and circumferential locking tab force is about 1.8 pounds on each locking tab. The user would have to forcibly apply over 11 pounds of total circumferential force to overcome the frictional forces on all six locking tabs. The outer pot locking tabs are located about 5 inches from the center of rotation of the lid. A resulting lid torque of at least 55 in-lb would be required to overcome the 11 pounds of circumferential frictional force on the locking tabs located 5 inches from the center of the lid. Although there would be some variation in the analysis variables during actual testing, the reported lid removal torque of approximately 60 in-lb applied by the test technician during the lid removal tests exceeds the required calculated torque of 55 in-lb to overcome locking tab friction.

MONITORING MECHANISM ANALYSIS

The cooker monitoring mechanisms were evaluated by systematically disabling each component. This examination documented cooker performance with the pressure release valve clogged, the float valve clogged, the temperature sensor disabled, and the pressure sensor disabled. With either sensor disconnected, the pressure cooker was unable to operate and produced an error code on the control panel display.

The pressure release valve or the float valve was intentionally plugged to simulate the conditions of food particles lodged in the valves. During both of the clogged conditions, the cooker was still able to reach full operational pressure. In the case of a clogged pressure release valve, the pressure could not be manually dissipated and the lid could not be forcibly removed right away. The owner's manual addresses the situation of a clogged valve, and the directions describe a reasonable method to solve the problem. Instructions in the owner's manual also describe how to prevent clogging.

Figure 17 shows a comparison of the absolute pressure plots for a normally operating cooker with no valve clogs (test number 1), a cooker with a clogged pressure release (PR) valve (test number 16), and a cooker with a clogged float valve (test number 17). The plot shows that all three conditions appear to be similar in performance. The test result data also confirms that the performance of the pressure cookers is similar for the various conditions. The average maximum temperature was 244.48 °F for the unclogged condition, 243.06 °F for the clogged pressure release valve condition, and 244.43 °F for the clogged float valve condition. The average maximum absolute pressure was 190.1 kPa for the unclogged condition, 186.6 kPa for the clogged pressure release valve condition, and 189.5 kPa for the clogged float valve condition.

While the float valve or pressure release valve were intentionally clogged, it is important to note that the redundant mechanisms functioned as expected, and the cook cycle was otherwise normal. In the presence of an improperly functioning or clogged valve, the internal pressure sensor is still capable of modulating the pressure within the cooker. This is why the performance of the samples during the clogged valve tests was similar to the performance of the unclogged, normal test (test number 1). **Redundant monitoring features of the pressure cooker prevent development of extreme temperatures and pressures that could result in forceful ejection of appliance components.**

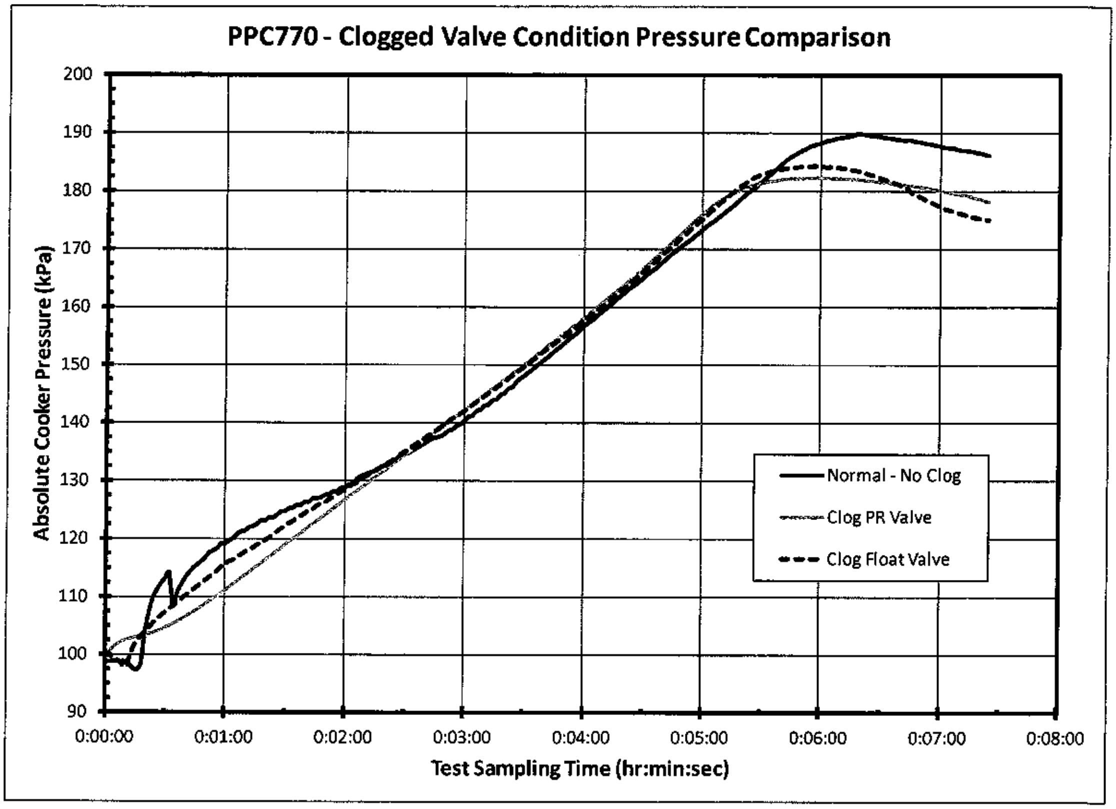


FIGURE 17: Comparison of the absolute pressure measurements for each valve clogging condition.

V. SIGNATURES

S-E-A hereby certifies the expressed opinions and conclusions have been formulated within a reasonable degree of professional certainty. They are based upon all of the information known by S-E-A as of the time this report was issued, as well as knowledge, skill, experience, training, and/or education.

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